

# Aviation Week & Space Technology

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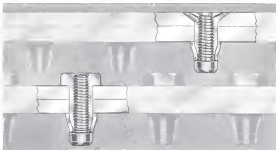
April 22, 1963

U.S.-European  
Comsat Program  
Is Anticipated

Franco-German  
C.160 Transall



Military, Space Uses for Lasers Investigated



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for blind and hard-to-get-to applications

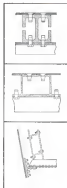
The K-Bolt measures up to and exceeds all the existing and proposed NAS specifications which set high standards of performance for single shear-double shear, tensile capabilities, sheet take-up, clamp-up, pre-load, tension-tension fatigue and some vibration.

Using existing sub-stock tools, K-Bolts are easily installed from one side of the work surface in blind or limited access areas. They can also be applied in easily accessible areas where weight savings is an important consideration. It is possible to save up to 50% in weight over the conventional bolting methods. Also, assembly time and related costs are reduced.

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First, a shielded wire shield protects the carcass by sealing cuts and cut-punch problems, which frequently necessitate early tire changes and prevent tire retreading.

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### AEROSPACE CALENDAR

**Apr. 29-30-1965 Spring Meeting**, Western States Section of the American Institute of Aeronautics and Astronautics, Sheraton Village Hotel, San Diego, Calif.  
**Apr. 29-May 1-1965 Annual Meeting**, Society of Aerospace Medical Engineers, Sheraton Village Hotel, San Diego, Calif.  
**Apr. 29-May 2-1965 Annual National Conference**, Society of Aerospace Medical Engineers, Sheraton Village Hotel, San Diego, Calif.

**Apr. 29-May 2-1965 Spring Meeting**, United States National Committee of International Scientific Radio Union (URSI), National Academy of Sciences National Research Council, Washington, D. C.

**Apr. 29-May 5-1965 Annual Conference**, Society of Photographic Scientists and Engineers, Automobile Hotel, Atlantic City, N. J.  
**Apr. 29-May 5-1965 Annual Conference**, Army Research Office, Atlantic City, N. J.

**May 1-1965 Letter D. Gordon Lecture**, by Edgar A. Sperry, Jr., on Early Airplane Instruments, Royal Aeronautical Society, London, England.

**May 1-1965 Annual National Forum**, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

**May 1-1965 Third National Conference on the Practical Use of Space**, Chicago, Ill. Sponsored by NASA, Committee for Economic and Cultural Development of Chicago.

**May 2-1965 Space Laboratory Control**, (Continued on page 7)

### AVIATION WEEK & SPACE TECHNOLOGY

April 22, 1965  
Vol. 28, No. 18

Delivered weekly with an additional issue on May 10, 1965. This publication is a must for all those concerned with the development of aircraft and space technology. It contains the latest news, developments, and technical information in the field of aviation and space. The publication is published by the American Institute of Aeronautics and Astronautics, Inc., 1633 Broadway, New York, N. Y. 10019.

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AVIATION WEEK & SPACE TECHNOLOGY, April 22, 1965

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## AEROSPACE CALENDAR

(Continued from page 5)

June 1969—Aerospace Medical Assn., Pacific Union Hotel, Los Angeles, Calif.  
May 24—North Atlantic Symposium on Human Factors in Shipboard, IEEE, Maritime User Budget Model, Washington, D.C.

May 24—International Travel Film and Flying Display, Rogers 250 Airport, Kent, England

May 3—1969 Annual Conference, Aerospace Assn. of Airport Operators, Gulf Coast Hotel, French Club and Crowl Ridge Hotel, Fort Lauderdale, Fla.

May 6—Aerospace Reliability and Maintainability Meeting, AAAA/ASME/AAE, Washington, D.C.

May 6—North Atlantic Aerospace Symposium, Instrument Society of America, Los Angeles, Calif.

May 7—Electronic Components Conference, Institute of Electrical and Electronic Engineers, International Inc., Wash. Region, D.C.

May 8—9—6th Meeting, National Aerospace Standards Committee of the Aerospace Industries Assn., Hotel Roosevelt, New York, N.Y.

May 8—10—Spring Meeting, Society for Environmental Aero-Acoustics, Hotel Roosevelt, New York, N.Y.

May 8—10—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Fort Worth, Tex.

May 13—15—National Aerospace Electronics Conference, IEEE/AAA, Dayton, Ohio

May 15—16—Fourth Annual Symposium on High Speed Testing, Hotel Somerset, Dallas, Texas, Space PlanTech Equipment Co.

May 15—17—Comsat-Conat Council Flight Forum's Second National Symposium on Air Transportation, Hartford, Conn.

May 18—Second Annual Management Conference on Marketing in the Defense Industry, American Marketing Assn., Boston College Campus, Boston, Mass.

May 20—21—17th Annual Convention and Exhibit, American Society for Quality Control, Sheraton Hotel, Georgia, Ill.

May 22—23—National Symposium on Micro Wave Theory and Techniques, Institute of Electrical and Electronics Engineers, Moscone Hotel, San Francisco, Calif.

May 22—23—National Telemetry Conference, William Hall, Albuquerque, N.M.

May 23—24—Reliability and Maintainability Training Council, Ames Research Corp., Moffett Field, Washington, D.C.

May 23—25—1969 Seminar Exhibit Stand with Engineers Society, Computer International Information Center, New York, N.Y.

May 23—24—Spring Joint Computer Conference, American Federation of Information Processing Societies, Cohen Hall, Detroit, Mich.

May 23—24—Symposium, Characteristics of the Laser Surface Boiling, Man Space Assn., Air Force Clubhouse, Research Laboratories, Arthur D. Little, Inc.

May 24—25—23rd Annual Meeting and News Conference, Aviation/Space Writers Assn., Adelphi Hotel, Dallas, Tex.

May 25—26—1969 National Conference on Product Engineering & Production, (Continued on page 9)

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## PROBLEMATIC RECREATIONS 167



Charles Connerly, a 1968 graduate mathematics student, was working on an assignment but, being a bit absent-minded, he forgot whether he was to add or to multiply the three different integers on his paper. He decided to do it both ways and reach to his surprise the answer was the same. What were the three different integers?

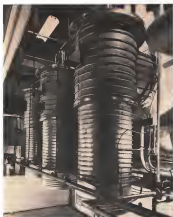
—Continued

The LC-4 Air Data Computer from the Guidance and Control Systems Division of Litton Systems, Inc., a truly modular flight data computer system, has some outstanding features we'd like to mention. For example, its attitude resolution is 1 foot at ten level and less than 5 feet maximum at 30,000 feet. Outputs, altitude, bank, heading, true airspeed, indicated airspeed, and static air temperature. We've got them to go into its display, read 90%, economy and ease of maintenance, so get the details from Air Data Systems, 2300 Congress Ave., Woodland Hills, Calif.

ANSWER TO LAST WEEK'S PROBLEM: The area of the white stripes is equal to the area of the blue field.

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**Dow Corning**

## AEROSPACE CALENDAR

- (Continued from page 7)
- Institute of Electrical and Electronic Engineers, General Hotel, Cambridge, Mass.
  - May 27-28 12th National Meeting, Optical Research Society of America, Sheraton Hotel, Cleveland, Ohio
  - May 27-29-17th Annual Frequency Control Symposium, Schenectady Hotel, Albany, N.Y.
  - June 1-5 Symposium on Materials and Processes for Space Power and Propulsion, Society of Aerospace Material and Process Engineers, Bellevue Sheraton Hotel, Bellevue, Wash.
  - June 5-11-42nd AIAA Fourth International Space Science, Singapore and South African Meeting, Wynberg, Pretoria
  - June 6-8 North American Radar Symposium, Institute of Science and Technology, University of Malaya, Kuala Lumpur
  - June 6-7 Symposium on the Exploration of Mars, Denver Hilton Hotel, Denver, Colo.
  - June 6-8 American Astronautical Society, Copeland American Astronautical Society, American Institute of Biological Sciences, AIAA, Rocky Mountain Section, NABA
  - June 7-8-19th National Maintenance & Operations Meeting, Reading, American Science, Reading, Pa.
  - June 7-11-11th French International Air Show, Le Bourget, Paris, France
  - June 11-14 Symposium on Plasma Space Science, The Catholic University of America, Washington, D.C., with the support of NASA and Goddard Space Flight Center
  - June 12-14-Hell Transfer and Fluid Mechanics Institute, American Institute of Aeronautics and Astronautics, California Institute of Technology, Pasadena
  - June 17-20-Summer Meeting, American Society of Aeronautics and Astronautics (AAS), Boca Raton, Fla.
  - June 17-21-Summer General Meeting, Institute of Electrical and Electronic Engineers, Toronto, Canada
  - June 18-20-21st Meeting, American Institute of Mechanical Engineers, American Society of Mechanical Engineers, Insurance Society of America
  - June 20-21-2nd Annual Donkey Physics, Double Beach Hotel, Donde, Puerto Rico
  - July 1-11-12th National Conference on Aerospace Education, National Aerospace Education Council, Hotel Danville, Milwaukee, Wis.
  - July 9-11-International Symposium on Space Telecommunications, Institute of Electrical and Electronic Engineers, Princeton Group on Astronautics and Propulsion, Boulder Laboratories, Boulder, Colo.
  - Aug. 18-21-76th Western Electronic Show and Convention (WESCON), San Francisco, San Francisco, Calif.

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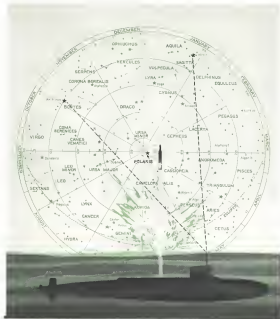
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## logistics

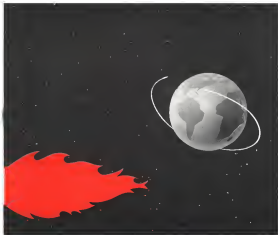
Bottles, and worse, too, have been lost by a breakdown in the transportation, quartering and supplying of troops in the world of engineering and construction, supply is as less important than in military operations. Particularly in remote foreign sites where purchasing, expediting, and delivery of materials must be carefully scheduled to coincide with job progress. Anything less than perfection results in delayed completions and soaring costs.

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## EDITORIAL

### Man on the Moon—Men on the Dole

(The importance and the cost of getting U.S. astronauts on the moon are being debated with more heat than in any time since the President committed the nation to this goal two years ago, as illustrated in the recent columns by James Reston, Washington Bureau chief for the New York Times. While we do not agree with all of Mr. Reston's conclusions, especially those of a Senate Transportation subcommittee, the aerospace industry should be fully aware of the growing doubts throughout the country about the wisdom of the heat and big program—ED.)

The debate on the nation's space program is getting out of hand. Some Republicans are attacking the program as if it were a lost cause, and President Kennedy is defending it as if it were the bill of rights.

Most of the extreme arguments, however, are sheer political maneuvering. The main issue is not one of politics but one of priorities. The question is not whether the exploration of space is important, but whether it is more important to put a man on the moon than to get several million out of the dole.

When the President was asked in his news conference the week about Cas. Eisenhower's attack on the budget in general and the space budget in particular, he seemed annoyed and immediately went into a political orbit.

The reaction was to compare his budget record with the worst of President Eisenhower, and to imply that anybody who wanted to cut the space budget was willing to hand over the space race to the Russians.

The space debate, however, deserves a more serious response. For a large and influential sector of the scientific community, of the nation, while enthusiastic about the exploration of space, believes that the scientific objectives of the program can be achieved at a fraction of the cost by pulling instruments, rather than men, on the moon.

#### Science or Propaganda

Thus, the issue, as they see it, is whether the man on the moon is essential for scientific purposes, or whether the massive additional cost of the man landing should take a higher priority than using a part of the savings as other essential funds that would regenerate the economy and create jobs.

Dr. Walter Wenzel, former president of the American Association for the Advancement of Science, recently said: "I believe that most scientists consider the proposed expenditures quite unwarranted as the pursuit of scientific considerations, and also consider the human part of the program to be wasteful."

Dr. James B. Kilgus, former president of Massachusetts Institute of Technology, has said: "Will several billion dollars a year additional for enhancing the quality of education not do more for the future of the U.S. and its position in the world than several billions a year additional for man in space?"

In 1960, the Administration spent on space, \$575,000,000; the next year the same went up to \$764,000,000; in the present fiscal year, the bill will be \$1,700,000,000; and for the coming fiscal year, the Administration has requested \$5,712,000,000.

Estimates of total space costs for the next five years. The deputy administrator of the space agency, Robert C. Seamans, Jr., has put it between \$30 billion and \$60 billion.

Fortune Magazine puts it at \$75-100 billion for a decade in which the nation shall also have spent \$30 billion on missiles.

It is not only some Republicans but prominent Democrats such as Chairman J. W. Fulbright of the Foreign Relations Committee who are asking whether the non-scientific part of that enormous total should be spent on a better man-landing rather than on projects that will ease the unemployment, education, illness, housing, and transportation problems here below.

The scientific objectives are, not primarily in question, but the propaganda objectives are. Fulbright, for one, is opposed to paying such a price for what he regards as a kind of lunar Olympic race to land a man on the moon, especially since he believes the nation's prestige will never be greater than its ability in housing, transport, education, and employ its own people.

#### Values and Priorities

What has happened here is fairly clear. The violent popular reaction to the first Soviet Sputnik has disrupted the Administration's sense of priorities and values, and the preference of the Congress for spectacular victories over the Russians has aggravated the imbalance.

Clearing slums and solving our unemployment raise more controversies on Capitol Hill than shooting John Glenn to the moon.

Accordingly, the Administration has said, in effect "Ask not what is best for the country, but what is worst to get through Congress."

It is an understandable position. The political struggle being what it is, but it does not satisfy, even the President's own closest scientific advisers. For they are the defense, atomic energy and space programs taking most of the creative scientific brains of the country; they do not believe the space experiments will help the civilian economy as much as the space subjects believe, and, Mr. Fulbright, they are not convinced that the cost of space programs will bring as much prestige as a booming economy.

"The difference today," said the President at Yale, "we must make of degree." This is the real issue about the space budget: not whether it should explore space but whether the degree of exploration should be so great as to spend tens of billions on propaganda as well.



**Steady as a Rock**



**Smooth as Silk**



**Fast as Lightning**



**That's the Kaman AH-64**



**KAMAN AIRCRAFT CORPORATION, BLOOMFIELD, CONNECTICUT**

## WHO'S WHERE

### In the Front Office

**Max Lehan**, controller, Defense Electronic Products, Radio Corp. of America (Garden N.Y.). **Robert M. Price**, manager of defense marketing, Aerojet-General Corp. (Azusa, Calif.). **John J. Smith**, vice president, Aerospace Industries Association (Washington, D.C.).

**F. Gordon Smith**, vice president, European Marketing, United Defense of Europe, Radio Corp. (with office in London, Switzerland). **Alan G. Minkoff**, board chairman, The Natick Corp., Dayton, N.J., succeeding Edward R. Scott, who continues in a director and member of the finance committee. **Dr. Jack W. Dwyer**, a director of Radio Electronics Inc., Silver Spring, Md. Dr. Dwyer is president and chairman of Dwyer and Associates Inc.

**George W. Smith, Jr.**, vice president, Westinghouse Air Brake Co., is continuing in general manager of WABCO's Industrial Products Div., Wheeling, Pa. **Mr. John R. Stark**, vice president, industrial relations and Charles D. Howell, vice president manufacturing and production, WABCO, Pittsburgh, Pa.

**Frank D. Langford**, vice president, government and industry relations, Schenck Electronic Systems, a division of Schenck Electric Products Inc., Wallingford, Conn. and Lawrence J. Shaw, vice president military contracting.

**Dr. Robert L. Bacon**, vice president, Long Island, Long Island Corp., a division of Sperry Rand Corp., Long Island City, N.Y. **Chas. T. Simpson**, a vice president, Fluke Corp., he continues in general manager of the company's VME Div., Palo Alto, Calif. **Vice President M. W. Newell** has been named general manager of Philco's Landolt Div., Ill.

**Robert H. Wood**, executive vice president of HIC, Inc., Winchester, Mass., has been named general manager of the company. **Also John H. Phipps**, general sales manager, Method M. Lines, continue to the president in with in manager of sales engineering, his previous position.

**Donald Kaprielian**, a division vice president and technical director of the General Products Group, Associates, Machine & Tooling Co., Cincinnati, Ohio.

**Vice President Robert L. Williams**, manager of the new, automated Marketing and Production Div., Archer Corp., Boston, Mass. and **John F. Kitch, Jr.**, head of the newly organized Commercial Services Dept. **Also Kenneth W. Gibbons**, senior vice president and manufacturing at Rockwell, Eugene, O. **Gibson**, manager to Mr. Colonel David F. Secaucus, director of engineering.

**William H. Gellman**, vice president, general manager, International Resistance Co., Philadelphia, Pa.

**Frank J. Roach**, vice president, former, Control Systems, Inc. **Dr. Gertie E. Etk**, chief operating officer and vice president in charge of the Las Vegas (Nev.) location of Edgerton Corporation & Co., Inc.

**Harvey A. Delaney**, vice president, engineering, Research Precision Products, Inc., Tarrytown, N.Y.

(Continued on page 121)

## INDUSTRY OBSERVER

Some engineering observers question the desirability after construction of the F111 (TX) in such a light as the fact that a clean-cut future engine performance growth. Industry studies have shown an almost certain in feasible and not limited to dash speeds just above Mach 2.

Component testing of Aerojet-General's M-4 liquid hydrogen rocket engine for open stages of space vehicles (AW Apr. 15, p. 35) will begin next week. First test fired will be the gas generator for the turbopump drive. Thrust chamber and pumps will start next late this year.

Biggest technical problem anticipated for the mobile medium-range ballistic missile (MMBRM) is expected in development of guidance. Question is whether or not the intelligent system's air traffic will be able to lock on proper target quickly enough and with sufficient accuracy to meet present target accuracy required for the weapon. Guidance system a long developed by General Precision's Aerospace Systems Div.

Kodak Research Laboratory at Edwards AFB has added industry to rebuild complete proposals for development and test of short-term test-launcher. Requirements include stipulation that the technique be non-hazardous and previously untried. Proposals are due the end of April.

At least seven firms including 16 major aerospace contractors are competing for the first-phase study effort of AADS-72, the proposed Army Air Defense System for 1970 (AW Apr. 15 p. 23). Teams are General Electric and Chrysler-Hughes, Douglas and Ford-Machinists Corp., Raytheon, IBM and Northrop's Northrup, RCA and Rockwell, Sperry Univac and Martin-Olin, Sylvania and Northrup, Westinghouse and General Dynamics-Aerodynamics. Three teams likely will be selected for the initial study by May 15.

Coated sample coupons with thermocouples for temperature measurements will be carried on sustained balloons attached to inflating vehicles to obtain temperature-control characteristics in space. Results will be correlated with available aerospace laboratory tests. Experiments will be conducted by U.S. Air Force's Aeromedical Systems Div., using such vehicles as Titan II, Blue Scout, or Discoverer series.

Pacific Missile Range tests for operations during Fiscal 1964 are expected to total \$175 million, an increase of approximately \$40 million over the current year's total. Navy operates PMR, providing range control and communications for Air Force, Navy and NASA launches from Vandenberg AFB, Pt. Arguello and Ft. Meigs, Calif., for Koppelman Island branches of the Nike Zeus anti-missile, in missile, and for Atlas and Titan ICBM training, shortly expected at the Bland AFB target area. USAF-operated Atlas Nike Zeus Range will require \$240 million in Fiscal 1964 for support of Air Force and Navy long range ballistic missiles, Army Penetration ballistic missile development programs and NASA space shots.

Optical communications facility suitable for long-range optical communication will be studied for Air Force's Remote Air Developmental Control (RAID) is one of several Air Force Systems Command centers actively pursuing application of optical means to radio communications, surveillance and other military uses (AW Apr. 22, p. 54).

Defense Dept. is seeking a refined form of Thakral Chemical Corp., based on pressing pellets for a sub-pelletizer boiler used in the company's chemical operations to its own Longhorn rocket plant at Midland, Tex. Thakral's cost or manufacturability estimates all have earned a charge permitting charging of commercial prices for the chemical products. Defense now expects to push program. Refund claim sought for the period 1950-62 at \$4-55 million.

Air Force plans to fund construction of two more aircraft in the North American YAT-101 program for a counter-attack plane. First prototype, a modified T-28 powered by a single Lycoming T55 turbo-prop engine, crashed during a test flight (AW Apr. 1, p. 31).



**CONFIGURE**—The mathematical model for satellite thermal balance is established from the configuration and material properties.



**PREDICT**—The first test temperature correction of the satellite between sunlight and eclipse conditions is used only for conceptual studies of thermal balance capabilities.



**TEST**—The thermal model capacity is tested in the Bendix 300-4 JET system. The model with input values is tested with an actual satellite. Simulation is used to test the capacity for a specific set of conditions.



**COMPARE**—The results of the model are compared with the actual satellite data. The model is used to predict the results of the actual satellite data. The model is used to predict the results of the actual satellite data.

**SATELLITE THERMAL BALANCE** is confirmed by experimental verification of theoretical analysis. Such early confirmation is the key to reliable spacecraft development at Bendix where complete facilities support major programs from concept to flight test. Engineers in the space technologies can learn more of these challenges by contacting our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan, an equal opportunity employer.

**Bendix Systems Division**



**WHERE IDEAS  
UNLOCK  
THE FUTURE**

## Washington Roundup

### LeMay on 'Overkill'

Often-quoted question of whether the U.S. nuclear arsenal contains too much "overkill" capability, arose up again at recent House Defense Appropriations subcommittee hearings, and USAF Chief of Staff Gen. Curtis LeMay had this to say: "I'm sure people are adding up the weapons and assuming that even one of them is delivered on target and therefore, we destroy everything. Why do we not just have one rifle bullet for each man on the opposing side and let it go at that?" The answer is obvious, of course. "You are not going to kill a man with one rifle bullet." Can you guarantee one that an air force war will deliver methods of the U.S. weapons on target?

"From a strictly military standpoint," Gen. LeMay told the same subcommittee, he would prefer to see the U.S. maintain lower landing program "as a military aspect rather than just a scientific project—let science tell us what other than let the military applications tell us of it."

### Panned in Boston

Sen. Clifford Case of New Jersey will lead the probing of National Aeronautics and Space Administration budget cuts in a \$80 million deficit account. Case's office in Boston which Senate space committee hearings on NASA's budget began this week. Sen. Case has been complained to Sen. Case that they have had to try off employees because of lack of work. Even those Boston area scientists from have not been protesting, saying they fear that NASA will end them in gathering its staff for the next.

Close to being an indication of higher learning, into the Cape Canaveral, Fla., area is gaining momentum. Maj. Gen. Douglas L. Davis, commander of the Air Force Missile Test Center, and Dr. Kurt Debus, director of NASA's Launch Operations Center, spoke last week before a joint session of the Florida legislature, which is considering several bills to put a university or university extension somewhere in central Florida. "Academic campuses and military engineers are supporting the effort."

### Senate Aviation Lag

Senate aviation subcommittee is headed for a "do-nothing" label unless its pattern changes. The only matter Chairman Mike Mansfield has had the subcommittee explore since Congress convened last January is federal airport financing. This lack of action is consistent largely with the long list of subjects which Chairman Warren Magnuson of the great Commerce Committee and the subcommittee, would review. Sen. Magnuson has requested \$100,000 for operation of the committee and its subcommittee for the period of March through next January. He said in asking money for the aviation subcommittee that a focus on the financial plight of the airlines "ought prove highly beneficial." But Sen. Mansfield is displaying little interest in this or other aviation matters.

Development and production of 1,200 F-111 (TFX) tactical fighters will cost enough by U.S. estimates—\$0.5 billion—but it would cost considerably more if East German propaganda broadcasts were believed. One broadcast referred to the TFX situation as "another case of war propaganda," and said "no less than \$25 billion in the amount provided."

### Military Space Sharing

Defense International Research Program, under which Defense Dept. has cooperated with foreign scientists and their organizations since 1952, may eventually be extended into space "in order to ensure progress oriented military research efforts, continuing working relationships and efficient support, all of which are important to our national security," according to Dr. Lawrence L. Korman, special assistant for space to the director of defense research and engineering.

Air Force on July 1 will become the first service to have completed fully with Defense Dept. Project 1954, which directed that headquarters staffs be reduced substantially. Such work was responsive to the war the defense secretary's office has been, and under out of service management (see p. 35). Air Force actually anticipated delay of the organizational changes that have been ordered by Defense Dept. the past two years. Beginning with the shifting of most of its personnel to other units, the Air Force had planned. The changes did not come early, however, and Vice Chief of Staff Gen. William F. McCreedy had to step in and save some internal peace talks.

### Indian MIG Factories

Town of Nash in India's Maharashtra province has been selected for a MIG aircraft factory and the town of Kanpur in the province of Orissa for an aircraft engine factory. Both of which Russia will help build, Indian Deputy Defense Minister D. K. Ghosh said last week. He said the plants should begin operation in 15 to 16 months.

Secret Defense Minister Robson Mahasany was understood to have promised Indonesia on his visit there last month that Russia will supply enough more T-16s to help Indonesia build a full squadron of 20 to 30 T-16s. Indonesia is now in the process of building and other aircraft. Indonesia some time ago but a number of the bombers have been lost in test operations and flights by Indonesian pilots.

In still another shift of top Russian scientific officers, Marshal Nikolai Khrushchev has been named commander of Soviet rocket forces. The job was vacated recently by Marshal Sergei Biryukov, who was named chief of the general staff (Apr. 8, p. 31). Khrushchev has been commander of the Moscow military district. —Washington Staff



# New GE Apollo Role May Be Challenged

By Alfred P. Abramo

**Washington**—Deputies last week to extend General Electric Co.'s contract for integration, checkout and reliability testing on Project Apollo to include support functions at the Mississippi Test Facility is expected to further arouse House space committee members, who have already questioned for the second year in a row National Aeronautics and Space Administration's handling of the contract. GE was chosen for the support role without a competition. It received the original contract in the same way.

On Feb. 9, 1962, NASA announced it had selected GE for the integration and checkout of Apollo. Absent from the contest, the House space committee questioned this contract.

In the current House hearings on the Fiscal 1964 budget, the House space subcommittee on tracking and data acquisition again examined the original NASA-GE relationship on Apollo.

There is some for concern as to the General Electric matter because that contract puts them in a preferred position and it seems to be that NASA should take over, great care to see that it [GE] does not take advantage of its position," Rep. Wilton F. Ryan (D-N.Y.) said.

Dr. Robert C. Seamans, Jr., NASA associate administrator, denied the GE contract. He explained that GE had been "isolated" from building on Apollo modules or the rocket stages in use as the lunar landing flight program.

At the same time," he said, "attention has been given to be sure that the

[GE] are not necessarily and severely prejudiced in its other capabilities."

Seamans said NASA headquarters had drafted its contract "that GE be considered for contract awards on the same basis as any other company, except for the Apollo mission."

Rep. Ryan replied that the director issued a new concern that "perhaps NASA is building more from its contract policy and has used the revenue on GE because of complaints to [NASA] from GE during the course of the last year."

Seamans responded that the price spelled out in the contract sent to the centers was "very fair and well thought out."

Reverend Haines director of manned space for NASA told the subcommittee that the GE contract would save about \$100 million in Fiscal 1964.

as much as \$125 million in Fiscal 1965 and a total of about \$600 million "and we are on the move [for] through the decade."

At no time during the questioning did Haines or Seamans mention extending the contract to other support activities at the Mississippi Test Facility. Description of these support activities in NASA, members of the space committee said, appear to be closer to the description of the Pan American-Burke Corp. of America role at Cape Canaveral, Fla., than to the Apollo checkout and integration role actually defined in the GE contract.

For instance the extension of the contract includes, according to NASA, such items as "in-flight personnel transportation, plane security, fire protection, medical facilities and photographic services—and test support"—such as control and communications systems, support services for data acquisition and handling, storage and handling of propellants, a companion facility and ship and field service.

NASA has estimated that the initial contract with GE for support at the Mississippi Test Facility will cost about \$15 million and, depending upon negotiations, the extension could save through 1968, resulting in estimated annual net of \$20 million in 1975.

Rep. Ryan said that the extension of

the GE contract "is certainly something we would like to look into," said House space subcommittee members. They have since the \$525-million NASA budget request submitted this week. The Senate space committee is scheduled to begin its hearings on the NASA budget April 24.

NASA's intent, to hold an open competition for the whole integration and checkout job produced some questioning of NASA officials last week (ENR April 2, 1962, p. 12). But it produced even less favorable answers as the exchange continued.

**Rep. Jacob J. Doolittle (R-Calif.)** "Do you give any other contractors the opportunity to present a proposal?"

**Seamans:** "Yes, we discussed this with other contractors."

**Doolittle:** "Which ones?"

## United Nations Committee Receives New Soviet Space Use Proposal

By Ward Wright

**United Nations, N.Y.**—New Soviet draft declaration concerning use of the language, based on United Nations United Arab Republic, and U.S. proposals for the peaceful exploration of outer space was submitted to the United Nations Space Committee's legal subcommittee last week.

Legal subcommittee met here for the first time last week since it failed to agree on basic principles for the peaceful exploration and use of outer space at Geneva in March, 1962.

Eleven-point Soviet draft declaration was submitted, the same as the nine-point declaration introduced in the legal subcommittee in Geneva with the addition of provisions making a state responsible for any damage or injury done by its space activities and guaranteeing a nation's sovereignty over its own objects in space.

**Observers Optimistic**

While the Soviet declaration evoked no major concerns to any particular nation and still recognizes previous noncommitment to the U.S., U.N. observers are optimistic regarding the subcommittee will be able to make some progress.

Optimism stems from what appears to be a new willingness on the part of the U.S. and other nations to discuss those proposals which are mutually agreeable.

State Dept.'s deputy legal advisor Leonard C. Meeker told the subcommittee the U.S. was willing to collect intelligence data in reconnaissance work in the atmosphere of all countries as it could be generally accepted. Meeker said there was a "consensus" emerging concerning assistance of as-

**Seamans:** "With Russia's declaration?"

**Doolittle:** "On Russia's declaration?"

**Seamans:** "We had the most detailed discussion with them, yes."

NASA and as an amendment of the GE contract extension, that selection of the firm for the support work would "involve management and improve efficiency."

NASA said that at the peak of Apollo support activities in 1968, GE would support 1,200 to 1,500 employees at the Mississippi Test Facility. GE and it would eventually have 1,000 to 4,000 employees on its payroll in the Apollo support at various locations.

Rep. Ryan asked if the Apollo Support Dept. at Dorton Beach, Fla. to carry out its contract with NASA on Apollo.

transmission and return of space vehicles and their personnel.

Meeker and there was also general agreement emerging from conversations with members of the legal subcommittee that a number of basic principles related to peaceful exploration and use of outer space. The subcommittee might be able to reach agreement on those areas where agreement seems to be clearly indicated, he said. Whether the Soviet Union would subscribe to this approach remains to be seen.

**U.S. Objections**

Indications are, however, that the U.S. would not modify its original proposals in Soviet proposals language provide specific vehicles such as "Telstar" and "Satellite" for reconnaissance and use of outer space.

U.S. thinking is that a ban on private space activities is merely another way of extending Marshall doctrine to a new area. The Soviet proposal for use of outer space for war preparation or promotion of national or racial hatred is seen as the major concern in its present form. Questions remain raised which divides opinion as to proposals and what is "peace" proposals.

A ban on reconnaissance activities is seen as precluding a number of peaceful nuclear functions such as fire detection, and others.

Soviet space committee member Dr. Nikolai T. Fedorenko told the subcommittee that the use of satellites to collect intelligence data is reconnaissance work in the atmosphere of all countries which have been agreed upon. However the U.S. feels that as a reconnaissance satellite is beyond the pole

of military law as an Soviet transmits information beyond the three-mile limit.

Those provisions that were introduced in the Soviet draft declaration include the following:

• Outer space and outer space objects should be used for the benefit and interests of all mankind.

• Outer space and celestial bodies are free for exploration by all states, sovereignty over outer space or celestial bodies cannot be acquired by any occupation or in any other way.

• All states have equal rights to explore and use outer space.

• Activities of states pertaining to the exploration and use of outer space must be carried out in accordance with the principles of the United Nations Charter and with other generally recognized principles of international law to the extent of developing friendly relations among nations and of maintaining international peace and security.

• The use of outer space for propagating war national or racial hatred or enmity between nations is prohibited.

• Cooperation and mutual assistance on the conquest of outer space shall be a duty incumbent upon all states, any measures that might in any way hinder exploration or use of outer space for peaceful purposes of other countries must be implemented only after prior discussion and agreement upon such measures between the countries concerned.

• All activities of any kind pertaining to the exploration and use of outer space shall be carried out only by states. It states undertake collective space activities either through international organizations or otherwise such participating state must comply with the principles of the declaration.

• States shall retain their sovereign rights over objects they launch into outer space. Rights of ownership in respect to objects launched into outer space and their component means unaffected while they are in outer space and upon their return to earth.

• The use of artificial satellites for the collection of intelligence information is the territory of a foreign state is incompatible with the objectives of mankind in its conquest of outer space.

• States shall regard comets as objects of mankind in outer space and shall render all possible assistance to space-ships and their crews which may make an emergency landing on the territory of a foreign state or in any other space-ships or capable land beyond the limits of the launching state shall be returned to the state that launched them.

A state which launches any object in outer space bears international responsibility for damage done to a foreign state or to its property or personnel or persons in a result of such activities.



Full-Scale Reply 2C Model Shown

Full-scale, lightweight test model of Reply 2C component, developed for joint Atomic Energy Commission-Air Force Project program is shown at Johns Hopkins Univ., section test area. In flying configuration, it would be ready-to-launch, then heated by a rocket motor heat exchanger, returning the model for reusability test supply. Phase of investigation (right) is being completed to determine. Reactor was built at Lawrence Radiation Laboratory, Livermore, Calif. Manufacture Corp., Van Nuys, Calif. supplied engine block and associated technology.

## Cosmos Points to Space Spectacular

Moscow-Soviet Russia launched the first satellite in the Cosmos series Apr. 14, creating speculation here that USSR is preparing another manned space flight prospects.

Cosmos 14, according to the Soviet space agency Tsiu is transmitting data on a 28,000 mi. frequency. It is in an orbit ranging from 164.5 to 117.4 mi. Period is 101.6 min. and the inclination to the equator, 40.87 deg.

The satellite was launched the day after the second anniversary of the world's first manned space flight since Apr. 12, 1961, by Lt. Col. Yuri Gagarin.

An article prominently written by two famous unidentified Soviet astronauts said their duty was filled in capacity with studies and training sessions. The article also said Gagarin was doing an overall and had made a possible jump a few days earlier.

Antisatellite Analysis (Eugene) writing in French concluded a series of Soviet space tests with the statement that Russia has "fully completed" that phase in space research with its scientific and military space program.

It said the Cosmos satellite sent a "proving" a great amount of data for studies of the atmosphere, composition systems of the sun, cosmic rays and astronomical.

It also said that not just Kosmos 14 among the Soviet Union's space achievements. There is a belief in the Western world that the launch is herald in an attempt to soft-launch an antisatellite program on the lunar mission (NAV Apr. 10 p. 38). The article USSR announced, Lt. Col. Gagarin Tsiu, was quoted as saying that "subsequent" would mark in Kosmos 47 will "blaze the trail for astronauts" in flights to the moon and planets.

World Market, corresponding member of the USSR Academy of Sciences noted in the newspaper Komsomolskaya Pravda that while certain will continue in Russia to test new, antisatellite means for their boundaries. He said that a flight of the Soviet flight because it is hoped that "astronauts and designers will evolve... a means to overcome this obstacle with relative ease."

Several other Soviet articles noted continued U.S. missiles, which are targets for "defense of homeland" with Soviet rockets "which deviate from their targets by only 1 to 2 km... and at times even less."

line to \$178,000 outstanding shares. The company with a book value of \$23 per share (market value \$52.55) for in aggregate of about \$80 million for McDonnell's \$375,000 outstanding shares (note).

On this basis, the McDonnell proposal would require Douglas stockholders to give up a total of \$150 million book value stock for \$90 million in return.

### DC-9 Decision

Recent decisions to build the DC-9 (NAV Apr. 13, p. 46) based on a \$1 billion market forecast will include \$175 million for subcontractors, President Donald Douglas Jr. said in outlining future company plans.

Donald W. Douglas, Sr., defended the company's commitment to subcontract major portions of the DC-9 program in Canada on the basis of prospective aircraft orders from that country. The only specific subcontractor mentioned was de Havilland Aircraft of Canada. Total expected Canadian work is estimated to run as high as \$0.50 aircraft.

DC-9 program as viewed by Donald Douglas Jr. as the driver in an effort to increase development costs of the DC-9 program, which was being brought to the company through aircraft order. Total DC-9 program development cost, however, has not been increased, according to Douglas.

### Stock Sale

Donald Douglas, Sr., declared he expects to sell 5,000 shares of stock in the company, 5 years to completion of the \$1 billion in assets, on the basis that he was considering the welfare of his descendants. At 71, he said, he couldn't expect too much legacy to a future with the company.

New York Times (NAV Apr. 13) says the company is developing include a follow-on version to the A1E, proposed to the Navy, and a C-130 military transport replacement, which would be a new large jet aircraft. The latter aircraft is now in development stage.

### Hughes' Option

Hughes Dynatronics Inc. wholly owned subsidiary of Hughes Tool Co. has acquired a 30 sec option to purchase a majority of the stock of Hughes Electronics Inc., maker of data recording and computer input devices and leader in the field of product planning at Hughes Electronics has been named general manager of Dynatronics as part of an agreement under which Hughes will provide savings of services to Hughes Electronics for the period that the option is in effect.

## Defense Interest in Prototypes Renewed

Washington-Defense Dept. is showing renewed interest in a return to multiple prototype aircraft rather than production of a single highly detailed design-the practice during the last two years-according to Dr. John H. McLean, deputy director of defense research and engineering for tactical warfare programs.

A recent analysis conducted by the Rand Corp., an Air Force-sponsored research company, has shown that multiple prototype work will speed, in it is suited to improved overall performance and provided suitable option for response to new weapons. McLean held a meeting of the National Rocket Club here last week.

A recent analysis conducted by the Rand Corp., an Air Force-sponsored research company, has shown that multiple prototype work will speed, in it is suited to improved overall performance and provided suitable option for response to new weapons. McLean held a meeting of the National Rocket Club here last week.

On this subject, Dr. McLean had the following to say:

- No final decision on the VAX development project will be made until the summer. Current studies, he said, he believed the VAX should be subordinated to the capabilities of March 12.

- Light communications (CCIN) aircraft will be the focus of the performance spectrum in conventional warfare (NAV Apr. 13, p. 35).

- When the McDonnell F-4B and F-4C weapons flight is completed for the first time, its top speed drops from Mach 2.7 to about Mach 1.7.

McLean said that the system goes for development of the multiple prototype system was that it cost more than the government would afford as just an experiment. The Rand report, he said, shows that the prototype method would be more costly and require options early in the program.

"The preparation of the Rand study probably involved several visits to the prototype approach, particularly in the field," he said, "but that is not what we demonstrated that the alternative to the prototype approach are not very desirable either, we will be doing so increasing concern that we should use the prototype system in our studies."

He cited examples of the current state of affairs (VOTD) aircraft now being developed, and the COIN results in the COIN program, he said the Defense Dept. now is looking at getting a state-of-the-art airplane rather than a complex system and ready system.

McLean defended the F-111 (TTD) as a method of development over existing aircraft. Its first stage aircraft produced and later stages of production, he said. In order to avoid the development of the F-111, it was necessary to discard several other approaches, such as a VTOL.

The VAX does appear as a small step, not a big step, but the F-111's operational capabilities, he said, it

should be developed only if it performs as well as tested by another aircraft. He said there are the other schools of thought on the VAX.

- No need for a VAX. Some Air Force officials feel the F-111 can handle all the VAX designs in its own line. Since the VAX would require the F-111 to be shut down and landing (STOL) capabilities, the F-111's load could be reduced to that of the VAX in the airplane could equal the VAX (NAV Apr. 13).

- There are many conventional surface systems in which it would be feasible to use an airplane aircraft such as the TFX. A multiple change system would do the job just as well, and that could be bought in greater quantities.

Some Air, Navy and Marine Corps officials support this idea, with the Navy saying a large aircraft than the Army and Marine Corps.

- VAX should have some distinctive capabilities, such as VTOL. The office of the director of defense research and

engineering believe that the technology is not ready for this approach at this time.

Defense Dept. research staff decide whether to invest up to a current design support system in develop a new one. It has not been decided yet whether the VAX should be released as an interim, although McLean stated earlier questioning that he favored the interim approach.

"The COIN aircraft, he said, is planned as a replacement for many low-performance and transport aircraft in the military and program (MSP) aircraft. It would also serve the Marine Corps requirement for a helicopter carrier, he said.

"We have considered it as a surveillance aircraft with mission for reconnaissance," he said. "This is aimed with multirole and mission is designed in the future, such as such as mission to deliver air performance mission in low grade warfare, and if necessary, might take in a part of the lower spectrum of the VAX mission. Perhaps it can be put into operation in the near future, he said.

He said the VAX and further study the VAX requirement."

Dr. McLean said that many tactical weapons now in the inventory, he said, are obsolete and have two main capabilities. He cited the Red Bull missile as an example. The enhanced range, land-based launch system now is expected to be replaced by a new missile. The Red Bull is under in one week, he said, he has been told of the inside the operational system would be in use soon, he said.

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## Douglas Voids McDonnell Merger

Los Angeles-Air, possibility of a merger between Douglas Aircraft Co. and McDonnell Aircraft Corp. (NAV Apr. 1, p. 28) was ruled out by Douglas Board Chairman Donald W. Douglas, Sr., in a firmly worded statement to his company's stockholders at the annual meeting in Los Angeles last week.

"We can not speak merger yet," Douglas said, "and are continually in touch as opportunities for merger or acquisition that he might be merged at present by McDonnell but not at this time," he said.

- Since both companies are in similar business and have similar capabilities, a merger of the two would result, rather than previous. Further, presentment of government contracts, based on the fact they only a single company could be holding either than two companies are authorized. In addition, past experience indicated that a great deal of subcon work would have to be put up for competitive bidding and might be, authorized to outside companies rather than among member plants Douglas said.

A combination between units of the two merged companies, because of the distance between California and Missouri, might result in substantial additional expenses.

local expenses units than in operating separately.

- A full divestiture and expansion into different new fields would be expected from the merger, due to the similarity of the two companies.

- Merger with McDonnell would allow Douglas to Douglas, long-standing spokesman for competition in the commercial transport field, according to Douglas. In a recent negotiation with a DC-8 customer, Douglas and the other two companies, using their own times, had been agreed that no merger was in prospect.

- Merger would not be fair to Douglas stockholders. McDonnell proposed that Douglas and McDonnell stockholders exchange present holdings for shares in a holding company, which would own both firms. The exchange was to be on the basis of present market value, which would mean that McDonnell share would be paid to approximately two Douglas shares. Such a proposal would require net asset value of the company, a basic measure of corporate value, according to Douglas.

In closing the merger on this basis, the book value of Douglas shares would be \$52.80 (market value about \$25), representing an aggregate of \$145 mil-



## Government Files \$1.2-Million Tax Claim Against Umbagog Aircraft

By David A. Brown

Federal government has filed a tax claim of approximately \$1,241,000 against the Umbagog Aircraft Corp., currently being reorganized under Chapter 11 of the Federal Bankruptcy Act as a Federal Court in Tampa, Fla.

V. A. Rule, Tampa lawyer who has been appointed trustee for the Umbagog company in the reorganization proceedings by Federal Judge Joseph F. Cobb of the Federal District Court of the Middle District of Florida, said, however, that he would object to the claim on the grounds that the funds in question were deposited and not taxable income.

Rule contends that income accrued by the Umbagog Aircraft Corp. was in the form of deposits on aircraft and that such income would not be subject to income tax under the Internal Revenue Code. He cited cases in *Wittman*, 314 and *Quila*, Fla., court accepted this interpretation.

Under Chapter 10, the court-appointed trustee of a company being reorganized has no claim or right to sue on claims against the company. If a claim is objected to, the claimant must prove their claim in court.

Rule was to submit a reorganization plan to the court in Tampa today, if the tax matter could be settled by that time. If not, the thing could be delayed.

At present, Raymond E. Umbagog and wife are major owners of the corporation's stock.

Umbagog Aircraft Corp., founded by Raymond E. Umbagog to manufacture and sell the Umbagog U-16 prototype, accepted Chapter 11 protection from numerous debts and distribution of its finished product to all the other aircraft owners. The company then sold a portion of the funds to develop, test and certify the U-16. On February 15, 1961, p. 37 Mar 28 1962 p. 141.

Trustee's plan during the litigation in Baltimore last spring showed that Umbagog Aircraft Corp. received \$2,475,188 from various orders, and distribution and spent \$1,991,178 on development and certification and \$234,534 for promotion of the aircraft.

Rule said a maximum of \$1.1 million would be returned to the aircraft owners. "The original company was underfunded to begin with," Rule said. "I don't believe that it would do any good to reorganize it with minimal financing."

At least three groups composed an effort to settle the company's financing and give control of the company,

Rule said. If Umbagog is not a member of the group which supplies the reorganization capital, he will become a minority stockholder.

However, one of the three groups is composed of the stockholders of the Pease-Roy Manufacturing Co. which claims Umbagog has been associated with it.

Also to be presented to the court later was a reorganization plan for Pease-Roy Manufacturing Corp., which is being assigned to him as an official coproduction under the trustee ship of John R. Treble, Jr., of Tampa.

Traditionally, the reorganization plan would call for a new corporation to be formed to take over the assets and liabilities of the Pease-Roy Manufacturing Corp. and of the Umbagog Aircraft Corp., if the Umbagog claim can be settled in time.

Otherwise, he said, the Pease-Roy firm, which owns the manufacturing rights to the Umbagog U-16 prototype, will be transferred and its assets and liabilities transferred to the new company, which will attempt to manufacture the U-16 at Baiton, Fla. Pease-Roy had leased production facilities of a winged aircraft firm.

Treble said at least \$1.5 million in new capital would be required before Pease-Roy's second plant could be able to accommodate production of the aircraft.

He told the Pease-Roy company had an outstanding obligation, pending settlement, for the claim made for approximately \$1,600,000 in paid-off outstanding loans.

Pease-Roy had already purchased the rights to the U-16 prototype, which, Rule said, the company has been giving flight demonstrations around the country in order to raise the necessary financing.

One of the proposals crashed last week, said the *Amalio* Times, while being demonstrated by a committee of the United States Chamber of Commerce. The plan was not approved and the aircraft is being repaired.

Pease-Roy was formed in February 1957, by associates of Umbagog and continued to manufacture the U-16 as well as other Umbagog aircraft. It also purchased the manufacturing rights in the U-16 from Pease-Roy in 1957. Agreed-upon settlement, along with the backing needed by Umbagog now.

Opponents of Umbagog protesting at the time, but were already attempting to place the assets of the Umbagog Aircraft Co. beyond their reach.

Raymond Umbagog owns no stock in

Pease-Roy, but is in an agreement with the stockholders to purchase the company's stock for \$500,000 sometime after February 1964.

Rule said that this agreement now is in a state of suspension and would undoubtedly be changed under terms of the reorganization plan submitted to the court.

In addition to the federal tax claim, Rule also has been presented with the most judgments against the Umbagog Aircraft Corp. awarded last year in Baltimore and Ocala, in the amounts of approximately \$481,536 and \$444,000 respectively.

Rule has indicated that he is a court order that he be the case. The claimants will have to pay their claims in the court as well as the federal government in the matter of the tax claim.

If the district court upheld the trustee, the claimants will have the right to appeal the decision to the United States Circuit Court of Appeals.

Creation of the company are divided in classes and each class must approve the reorganization plan by an 80% vote. The plan must also be approved by about 75 or 80 claimants at present.

## Thiokol Wins Three Large Solid Awards

Washington — Thiokol Chemical Corp. last week was awarded the major share of the Air Force large solid-propellant motor development program (AWAF 15, p. 31).

Thiokol will share Package 1 development state design of half length, 250 to 300,000 lb thrust, Scout/Gemini solid rocket motor for the Air Force. Package 2, the development state design of a 150,000 to 200,000 lb thrust motor with variable nozzle.

Package 4, the state design of a 150,000 to 200,000 lb thrust, single-segment solid rocket motor using a 150,000 lb thrust motor, was awarded to Lockheed Propulsion Co.

Thiokol will work on packages 1 and 2 at its Camden Canine, Ca., plant, and its new under construction. Package 4 will be done at the Wauson Th, W. Virginia City, Utah.

Aircraft will do work at the Duke County, Pa., plant, also being built now. Lockheed will do work at Red Lake, Minn.

An originally recommended by the source information, Package 2 would have gone to Aerojet Package 3 to Lockheed and Package 4 is United Technologies at about 150,000 lb, p. 20.

One of the two 200,000-lb motors eventually will be chosen to demonstrate a full length motor.

## USAF Implements Headquarters Changes

By Larry Booth

Washington — An Air Force plan to shift by July 1 the last 10 percent of system development responsibility from the Air Staff Headquarters to the Systems Command and the Logistics Command, and to change responsibilities within the Air Staff.

In an Air Staff directive, Gen. William J. McKittrick, vice chief of staff, began implementation of recommendations made in a Project 70A report (AF 11, p. 14). The move will adjust the size of the staff in the new Air Staff Headquarters.

Headquarters will place most system development phase monitoring functions on the hands of the deputy chief of staff for research and development (DCS-R&D).

About 50 officers and civilians will be shifted from the deputy chief of staff for systems and logistics (DCS-S&L) to DCS-R&D.

No estimate has been made of how many personnel will be made available to the Systems Command and other field commands but the Air Staff eventually will be reduced by 25%.

DCS-R&D will gain all of a day's work under the executive for material

procurement which now performs the research and development program functions for DCS-S&L. This move will make the command more self-sufficient and more closely coordinated with the National Aeronautics and Space Administration and civilian government agencies except for nuclear weapons, for the headquarters.

• To be decentralized: Air Staff portions of the responsibilities covered by the former Air Staff Staff (Systems Command) that has been decentralized or transferred to the Systems Command and the Logistics Command. The former Air Staff Staff (Systems Command) that has been decentralized or transferred to the Systems Command and the Logistics Command. The former Air Staff Staff (Systems Command) that has been decentralized or transferred to the Systems Command and the Logistics Command.

DCS-R&D will retain responsibility during the program definition phase, which can be defined as "conceptual" in the state of the art, in which case DCS-S&L would have primary responsibility.

DCS-R&D will retain responsibility during the program definition phase, which can be defined as "conceptual" in the state of the art, in which case DCS-S&L would have primary responsibility.

Assignment of elements in program packages to the Secretary of Defense will be based on program status. The new Air Force responsibility will define program packages No. 6 (research and development) will be assigned to DCS-R&D except for the North American 3-11 missile, which remains under DCS-S&L. Under program package No. 6 (research and development) will be assigned to DCS-R&D except for the North American 3-11 missile, which remains under DCS-S&L.

Recent judgments within the staff were made principally at the time of the last report on the status of the program. The new Air Force responsibility will define program packages No. 6 (research and development) will be assigned to DCS-R&D except for the North American 3-11 missile, which remains under DCS-S&L.

Under program package No. 7 (general support) Project 1158, approval of whether will be transferred from DCS-S&L to DCS-R&D. Under program package 2 (research and development) will be assigned to DCS-R&D except for the North American 3-11 missile, which remains under DCS-S&L.

The decision under this list of only two, others assigned to DCS-S&L and DCS-S&L, also, as scheduled for next year, but do not have transfer orders to be prior to Systems Command.

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## Computer Use Shared

New programming techniques that enable users to share computer resources on a time-sharing basis is one of the key features of the new computer system developed by the Massachusetts Institute of Technology. The technique is an extension of the time-sharing concept to the applications and methods of use of the computer, according to Prof. Philip M. Morse, director of MIT's computer center.

One of the problems created last week of a separate mode can use the computer in 1970 computer and the new system closely will be required to 21 new computers it is required that more than 100 such computers will be connected with a central computer facility holding all vital documents and information to share in use.

The new technique supports new new and creative systems which will be the computer to use an computer in one user's problem for example 0.05 sec, adding to another program in the next 0.05 sec and so on.

To ensure the system runs at such high speeds, a shared system will be connected with a central computer facility holding all vital documents and information to share in use.

To ensure the system runs at such high speeds, a shared system will be connected with a central computer facility holding all vital documents and information to share in use.

## Stratoscope Results

Recent infrared scan of the planet Venus from the Stratoscope 2, balloon-borne telescope (AWAF 11, p. 74), showed no sign of a global warming in the planet's atmosphere, according to preliminary data released last week at the meeting of the American Astronomical Society in Tucson, Ariz.

Concentrations of carbon dioxide were found to be 10 times greater than on earth which is about 5 times greater than the current ground-based figure. Stratoscope 2 telescope scanned Venus for about 45 min at an altitude of approximately 70,000 ft.

## NATO Moves Toward Coordinated Targeting

Paris—Definite form of the international command structure for nuclear weapon systems remains in the North Atlantic Treaty Organization's school shed to be hammered out next month at an Ottawa meeting among representatives of eight NATO countries.

Major initial task of the new command will be to devise a common targeting structure for the nuclear weapon carrier of the nations involved in order to avoid overlap and provide the best possible coverage. Most of the units to be immediately affected will be tactical aircraft squadrons located in Western Europe, including two French squadrons of F-100s in West Germany.

However, the three American Polaris submarines assigned to the Mediterranean area probably also will obtain their targets from the new command, whose authority also may eventually extend to USAT units in Spain and perhaps later, to others within the U.S.

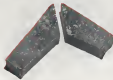
France's nuclear-independent air force also may be included at some future date. President Charles de Gaulle, in declining France's role for an independent nuclear force, has indicated that he would not object to a common targeting policy for his D-519 Swift Strife bomber force, but no agreement as this has yet been made.

The new command is scheduled to be located at Supreme Headquarters Allied Powers Europe (SHAPE) near Paris and be directly responsible to Gen. Lucian L. Lemnitzer, supreme commander of the powers in Europe.

Major questions still to be resolved is just how much control the individual participating nations can exercise over the command of the new command. This problem also will be discussed at Ottawa by the representatives of the U.S., United Kingdom, France, West Germany, Italy, Belgium, The Netherlands and Canada. When the new command has finished out here, either this month or during summer, relations between top NATO and European national officials on the one hand, and Secretary of State Dean Rusk and Defense Secretary Robert McNamara.

Some initial U.S. reports of the meetings indicated that France was anxious to have its desired for its independent nuclear force, and after first reporting it, was now willing to join the U.S. command and contribute to the plans for NATO. France desired these reports.

Strained in West Germany, the two French F-100 squadrons often under NATO control and when France agreed that they should be supplied with U.S. nuclear weapons, it also agreed that those weapons would remain under American control.



## Edible Space Structure Material Tested

Edible structural material harder than tempered Macawite is being developed by Commanco Aircraft Engineering Corp. for possible use in secondary structures—padding, empennage and control surfaces—in future spacecraft and light airplanes.

Material—a sort of space-age pemmican—was invented by Dr. Sidney Schwartz, a physiologist associated with the Lunar Extraterrestrial Module project.

"We're edible structure available," Dr. Schwartz told Aviation Week & Space Technology, "we can reduce the need for loading food in space flight." He cited the LEM as an example—in addition to having a large amount of can-lining—bearing structure for housing spare parts and substructure. The vehicle will shoo out its spare loading gear on the surface of the moon. Features of this could undoubtedly be made of edible material.

Dr. Schwartz said that he received his inspiration from reading of how in nuclear explosions left clouds of dust fall behind him, which served the double purpose of marking his trail and feeding his dog dogs on the return trip.

With the concept of a dual-purpose material in mind, Dr. Schwartz drew up a list of supplies which he purchased at a local grocery store. In a total outlay of \$450 the recipe calls for white wheat flour, corn starch, powdered milk, powdered banana and banana, gelatin, butter, sugar, and the basic function is given in sum form—to be heated for nine months in a liquidable pot.

The result was a dark brown, molasses-like substance possessing a Rockwell-style hardness of 57, equipped with 10 lb tensile Macawite and 120 lb shear stress. One positive strength of the material is 7,214 psi, tensile density is 0.046 lb per cu in. and volume density is approximately 100 and per ounce.

In structural applications the material can be machined, cast, drilled and tapped as the same manner as Macawite, Dr. Schwartz said, as it can be molded to make final parts and special shapes such as bolts.

Machined as he refers after being compressed by loading in water at 100 lb for 21 hr or at room temperature for 41 hr. Its force is not unlike that of bakelite wood, Dr. Schwartz said, and in an emergency, it can be crushed or shipped with a fork and the dry fragments eaten.

Dr. Schwartz is considering the use of a Mylar aluminum and polyethylene in laminates for containing the radioactive and water contents of the material. This laminate—which is commercially known as Viteloid—could be used and shipped off before being used as a food.

Showing the material that the material shown in the above photo is only his second recipe—the first was too brittle before the addition of the banana gelatin—Dr. Schwartz said that he felt confident that he could optimize the formula increasing its mechanical strength, force and nutritional value.

The only other edible structure found in Commanco's laboratory is the patent file prior to applying for a patent was the so-called case. Dr. Schwartz added Commanco's patent will be on the process involved in making the edible structure material, rather than on the concept.



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# Northeast Decision Seen Aimed at Hughes

**CAB examiner's finding that airline is unfit for Florida routes viewed as bid for more Toulco financial aid.**

By Robert H. Cook

Washington—Civil Aeronautics Board examiners' recommendation that Northeast Airlines' bid for renewal of its New York-Florida operating authority be rejected is being viewed within the airline industry as a deliberate attempt to force a showdown with indomitable owner Howard Hughes over his plans for the carrier.

Despite a detailed account of Northeast's disastrous experience in the market, Examiner Walter W. Bean left a definite impression that the airline could reduce its losses, restore financial profligacy that Hughes Tool Co. guarantees on time and stock, introduce financial support for the airline.

To date, the company has invested about \$12 million in Northeast on 511 million loss for net operating, \$5 million for its 50% controlling stock interest and purchase of \$15 million of subordinated debentures (see ENR 1/14/75).

Bean noted that the airline's loss record continues to worsen, despite the heavy financial transactions, and estimated Northeast will show an operating loss of \$4.3 million this year. Beginning with its first year of Florida operations, Northeast lost \$4 million in 1977, \$5.5 million in 1979, \$5 million in 1980 and \$3 million last year. CAB sources estimate Northeast's 1981 losses will be less than last year. Northeast is not now willing to accept such

cut without and capable of competing in the Florida market.

Only last year, the Board thought it had put Northeast on the way to continue to operate. Hughes said it would purchase of controlling interest in the airline Co. Hughes Tool Co. from the Atlas Corp. At that time, the airline was on the brink of bankruptcy, and CAB emphasized that its decision was intended to avert this possibility, along with preserving airline service in New England and protecting stockholder interests.

Now, the examiner contends, Toulco is not now willing to accept such

as further aid to Northeast, but has left a strong impression that unless the Florida renewal is granted, no further aid will be forthcoming.

In essence, Bean contends that since the future fate of Northeast is in the hands of Toulco, in virtue of the Board's approval of acquisition and since the company has made no further attempt to strengthen the airline financially, Northeast is unable to qualify as "fit, willing and able" for the Florida route.

As a result, Bean has recommended that the Board consider placing a new third carrier in the Eastern New York-Florida market along with an existing one, the adequacy of service as the New England and the short haul, commuter-type carriers of New York, Philadelphia, Baltimore and Washington, D.C. to Florida, and to New England, to continue to operate, but that the growth in service should be left to the private airlines, which he believes are better able to do so.

• **Amidst of the New York-Miami route** to Northeast, its operating loss, as a direct result of the airline's CAB, mentioned the decision of Examiner Thomas L. Weiss, who had selected Delta Air Lines as the most experienced and best equipped carrier to compete for the New York-Miami route. In choosing Northeast, the Board said it had done so to eliminate the airline's need for annual subsidy payments of \$1.5 million and to help it improve service and to secure a new flight schedule. As for competing CAB and it had "no doubt as to this issue" and predicted that Northeast's operation would be profitable on the basis of expected heavy traffic growth in the Florida market.

In retrospect, Bean's report leaves little doubt that the CAB's decision was correct. The airline's operating loss, which was the result of its heavy losses in the Florida market, was not a result of its heavy losses in the Florida market, but of its heavy losses in the Florida market. The airline's operating loss, which was the result of its heavy losses in the Florida market, was not a result of its heavy losses in the Florida market, but of its heavy losses in the Florida market.

Although both Eastern and Northeast have complained about the poor rate of traffic growth and the competitive impact of Northeast, the examiner contends that there is, and will continue to be, sufficient traffic for three carriers.

Bean's finding of Northeast's problems in its "overnight" match from local service to trunkline operations and a lack of steady financial backing. He also notes that the airline's market considerations are not for airlines



**Sikorsky Readies S-61N for Pakistan Airlines' Service**

Four of these Sikorsky S-61N helicopters will be shipped to Pakistan International Airlines in August, after Federal Aviation Agency certification. Second S-61N is scheduled for September delivery and the third next year. Helicopter in Pakistan markings was demonstrated to United Aircraft stockholders recently. Pakistan plans to inaugurate helicopter passenger service in East Pakistan.

but require service of established carriers with organizations and financial ability to compete on the basis of air miles of the route," he said. Accepting this statement at face value, since it is obvious that Bean's theory would give for financial aid to Northeast amounts to asking Toulco to "have faith" for the CAB to be able to do it at its own early arrival in some years.

• **Bean appears to contradict the** airline's claim that the airline would not meet the public need of Northeast unless it was reasonably sure the airline would be replaced in the Florida market. In the past, Toulco attempted to merge Texas World Airlines—75% of which is owned by Howard Hughes—Northeast. In the battle, that has ended over Hughes' control of TWA, management of the international airline sector that merger idea. Stripped of the laudable Florida route, Northeast would serve as a local service operation, unable to attract any of the Florida revenue to date as public favor in its markets. "However," Bean wrote, "this does not mean true prospecting Toulco continues in financial support."

It is considered unlikely that the CAB would in actual default of its present with Northeast particularly since it gave such approval of Toulco control of the airline, and Bean's decision is considered by many airline sources as a challenge to Hughes' rule, but might have Howard Hughes.

There is still nothing to the advantage of Toulco, since it will be more difficult before CAB decides the case. • Part of Bean's recommendation call for the Board to select a new carrier on the Florida route, but the application submitted in the current proceeding by Delta, Braniff and Pan American, was

quickly rejected. Although's application was recommended for separate consideration for new flight service, between Boston and Philadelphia, Bean said this should be considered later as a Board study of adequacy of service in the East Coast commuter markets.

Delta's proposal to lift several operating restrictions and permit it entry into the New York-Florida market during the Florida winter season was termed "a case of disinterest" that would not meet the public need of the airline.

Braniff's proposal to serve the route via a Washington, D.C. connection was termed a "fictitious" move to improve the airline's competitive position against Pan American in the United States. CAB rejected the move, since it was not in line with its long desire to acquire a domestic route, added that it be granted the route solely to a local airline. Braniff's plan, which it said, that the airline's own estimates, it would require part of the annual \$1.5 million subsidy to operate the route. "In the absence of interest of the domestic airline," it would mean diversion from National to subsidize the Pan American-Puerto Rico route, he said. • **Reaffirmation of Northeast from the**

Florida route, and its eventual replacement by a stronger carrier, could make new problems for both Northeast and Eastern. Since 1973, Eastern's share of traffic in the market has fallen from 62.7% to 42.5% by the end of last year. Northeast has managed to reach up from 32.7% to 34.7%, while Northeast has slipped from 5.0% to 22.8%.

Eastern, which hopes to merge with American Airlines, has been in a steadily worsening financial condition, so that a CAB rejection of its merger combined with the addition of a stronger competitor over its major Florida route, might bring increased efforts for subsidy from one of the largest trunk carriers.

Much of Northeast's gain on the Florida route last year was directly attributable to extra traffic picked up as a result of Eastern's fleet engine strike.

On the other hand, Northeast's growth in the market, made during a period of continued financial crisis, is not the industry's rapid growth to get itself, but failed to generate sufficient operating revenues to offset its financial loss.

• **Barriers of Northeast** to the role of a subsidized local service carrier in New England would not only be a total absence of demand for the Board, but would also be out of the program made in reducing the local service industry's annual subsidy bill. CAB granted the Florida route to Northeast in one series of eliminating a \$15 million subsidy bill. Under Bean's recommendations, the Board would require the New England service, with an eye to either restoring Northeast to selecting a new local service airline for the area. Either choice would probably require more subsidy, than that collected from even as in Northeast.

## TWA, UAL to Increase Flight Frequencies

New York—Agreements to 536 more seats a day will be added to transatlantic service by TWA and United Airlines, according to a statement issued by the two airlines.

TWA will add two additional to the three currently operating between New York and Los Angeles and will place a third on the San Francisco route. United will add two more between New York and each of the West Coast cities.

Including American's one daily additional in Los Angeles and three in San Francisco, the two airlines will operate in 1975 seats, compared with 2,800 during the last year. United's additions will be less during departure from New York, along with market for cargo and mail revenues in the foreign market.

TWA's move is a result of its increasing in additional Boeing 707-114B jetliners per week in the past year. The carrier had earlier reduced transatlantic service from two flights a week to one. The increase was based on the airline's 1982 report.

• **To replace declining price competition with higher prices** and to increase the competitive disadvantage resulting from fewer schedules, TWA's move will further expose to the transatlantic market, according to Toulco and United. "To do otherwise would result in a gradual reduction of the airline's service."

Flightlink, a service to add from a competitive reduction in transatlantic for TWA, American and United in an effort to correct the competitive position. However, United and American have expressed no intention to the proposal.

Subsidy sources report that American will let the carrier to increase its flight schedules to maintain the frequency advantage it held last winter.

## Delta DC-9 Decision

Delta Air Lines will purchase a short-range medium transport and the company's decision probably will make a decision on the aircraft when that next Wednesday. Chances are strong that the Douglas DC-9 will be selected.

Long time of Douglas Industries was in the carrier's Atlanta, Ga., headquarters last week engaging in discussions with Delta officials.



# Tabso Seeks Turbojets to Boost Traffic

By Edith Walcott

Sofia-Tabso Bulgarian Air Transport plans its first turbojet aircraft order soon to enable it to compete more effectively on Western Europe.

Possible choice of the state-owned airline will be the Soviet-built Tupolev Tu-124, newest medium-range transport with a passenger capacity of 36, 40 or 46 passengers. Latest aircraft now in service with Tabso is the 89-passenger Ilyushin Il-18 turboprop aircraft, which entered service with the airline last year.

The new turbojet is scheduled to replace a portion of Tabso's aging fleet of Ilyushin Il-14s on several medium-range routes in Europe, including Sofia-Plovdiv-Maria, Sofia-Copengagen and Sofia-Vienna.

## Intense Rivalry

The Il-14s will then be assigned almost exclusively to service on the airline's internal routes.

Firm decisions on type and number of jet transports to be purchased has not yet been reached, but the company's Propaganda and Advertising Manager, H. S. Simev, says that a first order for one or two will be placed once a final government approval is forthcoming.

By 1966, the carrier hopes to have six medium-range jet aircraft in service.

Following the recently concluded negotiations between the Bulgarian authorities and the French and British governments, Tabso will extend its West European network beginning June 1 to include seasonal, round-trip services to Paris and London. The carrier hopes to take gain landing rights at other French or Zurich en flights to and from Paris.

## Carrier Flights

The Il-18 transports to be operated on these new routes also will be used during the peak summer travel season to meet an increasing demand for transport flights between Sofia and Algeria, which has since March 1965 gained its independence from France.

Dependent on similar lines to Algeria and CSAR, Czechoslovak Airlines, Tabso concentrates primarily on passenger and cargo transport using Russian equipment exclusively.

Rapidly growing demand for expanding and post control on Bulgaria's collective and state-owned farms, or clubs and woodlands, has prompted the airline to increase substantially its present fleet of 30 Antonov An-2 biplanes and five Mi-4 helicopters within the next three years, according to the firm.

Estimated requirement at that time for this type of aircraft is approximately

150, most of them An-2s. Tabso, however, also hopes to acquire an unspecified number of Russian Mi-24 helicopters, eight-passenger helicopters. Despite their higher operational cost, adaptability of rotary-wing craft to a wide range of duties, particularly in the often inaccessible mountainous regions of Bulgaria is attracting the airline, to replace them as a steadily increasing force.

Additional services to be introduced with its planned enlarged fleet of turbojets, light aircraft will include tourist, sightseeing flights and, during the winter season, outfit of skis to ski resorts.

An airline spokesman says that thus far there is no demand for an air or shuttle service in Bulgaria, but that the government is preparing for the prospect of special flights such as fast and regular routes to major cities and towns from the agricultural heart of the country.

## Soviet Assistance

Established in June 1947, with Soviet-supplied technical and financial assistance, Tabso Bulgarian Air Transport is the country's first and only scheduled carrier to begin operations with a fleet of 100 aircraft, 140 and 150 airplanes, including light piston and jet, using three light aircraft families in 52 three-engine aircraft. First steps to be opened was a one-way round-trip service between Sofia and Burgas on the Black Sea coast region of Bulgaria.

Despite its rapid struggle to establish itself with local routes and facilities, Tabso has made slow but steady progress since that time. Its passenger transport service, which it has maintained on a seasonal basis, used the airline began service. As compared with a total of 20,900 passengers and about 650 tons of freight and mail carried on its combined internal and international routes in 1960, figures for last year were 304,450 and 1,867, respectively.

Employees now total 1,500, including 30 pilots.

In addition to the 30 An-2 biplanes and five Mi-4 helicopters, Tabso's fleet consists of nine Tu-124s, seven Il-18s, 14 Il-14s and three Il-18s.

First of the turboprop aircraft used into service with Tabso last May, the firm in December 14 month also can be added.

Regular international Il-18 round-trip flights operated by the Bulgarian carrier include:

- Sofia-Moscow once a week in summer, once a week in winter.

- Sofia-Plovdiv and Sofia-Vienna, each on a twice-a-week basis, in addition to two round-trip flights an operation during the peak summer season between these two cities and Vienna to satisfy the demand for travel to the popular Golden Sands area on Bulgaria's Black Sea.
- Sofia-Helsinki and Copengagen are served out of Sofia on a once-a-week seasonal basis, using Il-18s.

During the winter schedule change, the Il-18s are replaced by the smaller Il-14 on the Copengagen route.

Il-14 charter flights from Sofia, particularly during the summer travel season, include round trips to Helsinki, Kharlovka, Lufan, Rania and Alps. In addition, the Il-14 is used in Tabso's fleet, the carrier hopes to introduce regular once-a-week, round-trip service between Sofia and Algeria as well as taking an additional summer charter flight to Paris and London.

Il-14 operations:

- Sofia-East Berlin via Budapest and Prague twice a week in summer, once a week in winter.

- Sofia-Copengagen via Budapest and East Berlin once a week.

- Sofia-Vienna via Budapest, Sofia-Warsaw via Budapest and Sofia-Plovdiv via Vienna are each served once a week plus occasional tourist charter flights to these cities.

In addition, an Il-14 is stationed at both Vienna and Burgas to operate direct Vienna-East Berlin and Burgas-East Berlin round-trip flights on a twice-a-week basis during the summer.

## Domestic Network

Il-14s also are employed on Tabso's domestic network connecting Sofia and Helsinki and Sofia and Rome, each on a once-a-week basis, and Sofia and Burgas twice a week. The airline also operates two round-trip flights, one in each direction, over its internal Sofia-Copengagen-Vienna-Burgas-Sofia 72-point Sofia-Sofia route weekly.

At present, periods the Il-14s fly the Sofia-Plovdiv route weekly, with 12 flights each; at the intermediate stage the Il-14s, however, are scheduled to be phased out and replaced by Il-18s on Tabso's entire domestic network after the arrival of the new jet transports.

Tabso can that satisfactorily, including communications, and passenger and freight-handling facilities, at most of its domestic airports until to be modernized well, particularly at Burgas which is the connecting point for passengers on the carrier's Helsinki round-trip Berlin-Berlin route.

The airport at Burgas is not long enough to accommodate the Il-18, but work on modernization of the entire airport, including a larger concrete runway, has begun recently. It is scheduled for completion in about a year, according to an airline official.

# Tabso's Growth Pattern—1960-1962

|   | 1960    | 1961    | 1962    |
|---|---------|---------|---------|
| Domestic passenger aircraft                   | 182,780 | 151,900 | 267,510 |
| International passenger aircraft              | 25,100  | 35,800  | 50,500  |
| Domestic freight and mail/tonnes carried      | 525     | 125     | 605     |
| International freight and mail/tonnes carried | 1,077   | 236     | 1,259   |
| Total tonnage flown                           | 6,271   | 5,853   | 7,930   |

ated for completion in about a year, according to an airline official.

Annual evaluation rate of Tabso's Il-18s is expected to average about 1,700 or 1.55 ft. The Il-18 flight hours between 1,700 to 1,500 ft. the Il-18s between 1,400 and 1,500 ft. and the An-2 between 850 and 900 ft. per year. By May 1, when Tabso's 14 Il-18s complete their first full year of service, their utilization rate is expected to work out at about 300 ft. annually.

While major overhaul of the Il-18 airplanes and propellers are carried out at Moscow, the airline's technicians handle all other servicing and maintenance in its workshops at Sofia airport.

- Il-18s airplanes—Served on a progressive maintenance check basis with first check, scheduled after 75 flight hours, requiring 50 man-hours. Second check, requiring 254 man-hours, is made after 100 flight hours, the third after 1,000 flight hours, requiring 450 man-hours. Major overhaul of the Il-18s in France is made in Moscow after about 3,000 ft.

- Il-14 airplanes—Served on first check after 75 flight hours, requiring about 32 man-hours. Second is made after 150 flight hours, requiring 150 man-hours, the third after 800 flight hours, requiring 470 man-hours. Fourth after 1,500 flight hours, requiring 750 man-hours. Major overhaul is made after 4,000 flight hours, requiring 17,000 man-hours.

- First airplanes—First check is made after 100 flight hours, requiring 150 man-hours second after 300 flight hours, requiring 700 man-hours, the third after 900 flight hours, requiring 425 man-hours. Major overhaul is made after 1,600 flight hours, requiring approximately 9,000 man-hours.

- An-2 airplanes—First check is made after 500 flight hours, requiring 50 man-hours second after 100 flight hours, requiring 150 man-hours, the third after 300 flight hours, requiring 425 man-hours. Major overhaul is made after 1,600 flight hours, requiring approximately 9,000 man-hours.

- Propeller overhaul schedules are:
- Buhinski An-20 turboprop propellers for the Il-18s will go through major overhaul in Moscow after every 750 flight hours. Tabso says, however, that it has not yet completed details for its share of the Il-18 engine maintenance program.

- ASH-62 propellers for the Il-14s require their first check after 1,000 flight hours, and engines, requiring three days for overhaul. Additional checks, each requiring three days, are made after every 500 flight hours up to a maximum of 4,000 ft. when it is changed for a new, reconditioned propeller. Tabso says that the engine is able to double the ASH-62's present life span, pushing the total to about 5,000 flight hours.

- ASH-62 propellers for the Il-2s and An-2s, under their first check after 1,000 flight hours, with the work requiring two days to complete, and then after every additional 500 flight hours, each period requiring two days up to a maximum life of 4,000 flight hours.

Carrier maintains its own pilot training center at Sofia Airport. Students are chosen exclusively from youth living in or near party from the air force to be the partner with other East European carriers.

Tabso's basic requirement for acceptance is that the applicants must have completed a minimum of 500 flight hours prior to joining the airline.

## Special Training

Tabso's Il-18 crew received a month's special training from Russian instructors before their first flights. Tests were placed into regular service with the Bulgarian carrier.

Of Tabso's 70 pilots, 13 have each flown more than 1,247,000 miles and 40 of the others have each flown 621,000 or more. Their service with the airline: One early captain is a woman, in her early thirties—Mina Atanasova. She has logged approximately 1,117,000 miles since joining the 18 years she has served on Tabso's Il-14s.

There also are three women captains, each of whom has logged approximately half that number of flight hours. At present only KLM flight Dutch Airlines and AUA Austrian Airlines serve Sofia airport from the West on a regular basis although all scheduled Eastern bloc carriers stop there. The airport has a single 9,040-ft. long concrete runway. Existing installations are, limited, but appear to be adequate to cope with the volume of traffic likely to be handled here for a number of years to come.



TABSO BULGARIAN AIRLINES' present international route networks are represented by straight lines. Broken lines show new planned routes to be introduced in June, 1963.



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He was flying a P-51 in his 20's (when pilots sent bricks to each other to get extra pay for carrying mail).

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were on fire.

And the Coder that was so slow you could make a mistake and it would wait for you to correct it.

He taught the Army to fly the DC-3 (likes the G-47), and he went on to fly DC-6's and 7's and Electras, too. It took Jim Boyd 7 million miles to

get to the Astrojet. (Which is as far as you can go.)

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LOCKHEED ELECTRA 2 speeds American Flyers' move toward a jet-powered transport fleet. Cabin has acquired two of the planes.

## American Flyers Plans Piston Phaseout

By Ervin J. Balbus

**TL** WASH.—American Flyers Airline Corp., a major domestic carrier here, has added two new Lockheed Electra 2 turboprop transports to its current fleet of four C-46 Commanderos and four DC-3's.

This is an initial step toward phase-out of American Flyers' piston engine fleet and transition to turbo-powered aircraft. Raul Poyras, the carrier's founder and president, said the piston engine transport is "dead as a doornail" for charter operations, as well as scheduled airline service.

American Flyers plan to phase out its C-46's in about two years and replace them with long-range turboprop aircraft.

Previously a domestic U.S. operator, military charter and Air Movement (CAM) flights—about 75-80% of its business is in the west—and private charters, the airline lacks in acquiring jet transports with which to handle what it considers lucrative overseas military and passenger charter markets.

Evolution of available equipment has been going on for some time. Initially, Poyras considered the Convair 440, but he says he has eliminated this aircraft because it is too limited in capacity and range for American Flyers' type of operations.

Initially, he considered the DC-3, currently in the Douglas DC-59, primarily because of what he terms the versatility offered by its convertible

interior configuration, which permits a large variety of quick-change seating arrangements and the possibility of ready conversion to either partial passenger-cargo or full cargo loads.

Indications are that the piston engine equipment phase-out will apply only to the Commanderos—at least for some time to come—because American Flyers' DC-3's were introduced some time ago and are relatively economical for the carrier to operate. High cost of newer turbo-powered airplanes and the fact that the DC-3 is about the right size for AFA's business in this category weigh heavily against replacement of these airplanes.

Direct experience with the Electra 2 has exceeded the carrier's expectations. First, engine was delivered to American Flyers in Tucson and the second in Nevada. These are two of a batch of five controlled by Capital Airway when that carrier ran into financial difficulties and subsequently merged with United Air Lines.

American Flyers had its airplanes configured to be completely self-sufficient in ground handling facilities, including installation of Albeck's turbo-powered units in the tail to provide pneumatic power for engine starts, with AFA's alterations added to provide electrical power to its ground ground chock-out of instruments and radio.

American Flyers also currently is developing a "plug-in" amplifier's system for use in its newly acquired Electras,

to meet extensive piston requirements.

A flying instructor's table is being installed on the left-hand opposite the left-hand first row of passenger seats. No upper rest is on an aisle rest, with a mirror appearing low from the passenger and will allow a portugal console measuring approximately 2 ft wide, 1 ft high and 1 ft deep. Pedals will control radio control boxes, altimeter, autopilot and Lucas indicator and will be plugged into quick-connectors against the bulkhead.

American Flyers aviation operations will focus on the Pacific peninsula because it already has an established sales development office at Lockheed Air Terminal, Los Angeles, that maintains direct liaison with West Coast customers. This area also seems to provide the best market for optimum turboelectric charters airplanes with a measure of profitability.

Initially American Flyers will offer flights from San Francisco to Honolulu. Poyras, studies indicate that the Electra could cover the distance carrying 10 passengers with a 60-lb baggage allowance, and still have adequate fuel reserves. These data will have to await actual proving flights.

Operations over the Pacific may be started in June and the fall, with the airline soon tent to develop sufficient operating experience with its new airplanes in domestic flights. It also is interested in developing the Electra's role impact in its current market and over-



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The turbofan S-61R can fly 35 tons or 5,000 pounds of cargo 238 miles at 140 mph—or 5,000 pounds 328 miles. Operating costs will be the lowest in the medium transport class.

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ternal sling loading is also possible. The new fuselage design reduces drag and increases visibility on water in winds to 45 mph.

A modification of the proven SH-6A ARW weapons system, the S-61R offers Sikorsky-designed automatic flight control, AFU, 10-second blade inspection, blade folding, and consistently high mission availability. Deliveries to the Air Force will begin this year.

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ing the unusually heavy mission and full cluster takedown before taking on new assignments.

Since working the El Estora domestically is of low priority, indications are that it will be left before it gets Federal Aviation Agency approval on the plug-in navigator's station modification. Buildup of transport operations and route development would follow growth of the market and customer interest.

El Estora, which normally with 52 passengers, meets Military Air Transport Service test agency requirements for CAM operations. Such are first-class accommodations and have airstair doors open. Seat cushions are chains having built-in latches have been shortened to provide MATS required 26 in. clearance between edge of seat cushion and bulk heads.

El Estora's reliability was shown during American Flyers' proving flight for the Federal Aviation Agency, which covered 10,000 mi. and 25.5 flight hours with out a single mechanical incident. This would have been difficult to reach with a battery-powered transport, according to Pagan.

The El Estora's on-time performance rated with the airlines and its high acceptance by the public, were key factors in his choice of the equipment. Pagan and American Airlines, for example last year earned better than 2 million passengers on its El Estora. This accounted for approximately 25% of the total carried by the airline. Although the El Estora made up only 3.5% of its fleet and are not used on its most popular routes. In the last six months of 1962, American El Estora had a load factor of 63.5% and their engine maintenance, leaving the job on schedule or within 15 min. of scheduled time—on 51.6%. On-time performance during 1962 was the best in the carrier's fleet.

Carroll, Pagan says the addition of the two El Estoras is pending but also effort with a reliable and low cost emergency Constellation transport will be offered to charter groups which prefer comfort, cost speed and the El Estora will be offered to groups which prefer more modern, faster operation and do not consider price a major factor.

American Flyers, can load 61 in the Constellation at \$2.45 per mile plus 16 cents per mile less charge from the airport current location. A starting charge of \$50 per 12 hr. or less than that if added if the group wants to return the airplane in the course of days during that time. The El Estora is billed at \$1.15 per airplane mile, plus a landing charge of \$2.00 per mile, and \$200 waiting time. American Flyers has applied for a \$3.00 per airplane mile, rate on the new equipment but has to wait Civil Aviation Board approval on the bid.



TYPICAL CAM MOVEMENT of soldiers presented by American Flyers was the movement of 150 Oklahoma National Guardsmen to Twenty-Nine Palms, Calif. for summer training via chartered Constellation. The Constellation was used in the round trip movement.

Because the airline's cargo customer is MATS, the El Estora's higher plane mile rate, an important factor in bid for CAM movement. Air Force has been anxious for charter operators to obtain helicopter equipment for the end of an emergency of military personnel, but is reluctant about paying the higher tariff for the operators' sub-industrial use, therefore, that this airline probably will succeed in future military contract charters to having its airplanes placed so that the ferrying charges involved will be low enough to offset the higher fare cost.

CAM operations are highly complex from a scheduling viewpoint. Each of the approved contract operators but through their association on this point almost daily by the Military Transportation Service Agency. The possibilities here is lower the share-outs of all of the available aircraft before have two plus with an airport not as pricing and getting the cost.

As a measure of how much these airlines mean about in the course of a year American Flyers alone last year loaded 28,000 military charters carrying some 75,000 passengers, and 165 on-line group charters with the Constellation. Between 115,740 DC-7 cabin charter flights was flown. This totaled 25,414,024 passenger miles on CAM operations and 4,978,377 passenger miles on civilian charters.

American Flyers operations personnel figure the carrier has averaged some 80 charter flights per year per month up to release of the El Estora. This also covered includes the continental United

States, Canada, Mexico and Puerto Rico. Passengers ranged from Air Force troops being transported to training camps to school athletic teams and their fans.

The airline currently has two airplanes shuttling personnel and equipment between Hollywood and Glen Canyon, Ariz. where George Stevens Productions is filming "The Greatest Show on Earth." Service started last September and will run another year. DC-7 is generally used with an occasional Constellation flight for big loads.

Some charters involve large numbers—such as the three Constellation loads of 300 men from Tulsa to Miami and return and four plane loads of 400 men of Congressmen personnel from New Orleans to Los Vegas restaurants and hotels.

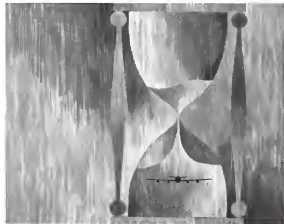
Military CAM business is a hot item from about April through the end of the year, while private charters are heaviest during the summer when vacation periods and conventions are at their peak. In addition, American Flyers is a supplemental carrier for isolated passenger programs. Number of isolated passengers allowed is fixed on a per centage of the previous year's business. Airline, authorized to handle \$104,000 of flight revenue included passenger miles last year but has increased 570,000-580,000 of the business to give industry buyers feel that the airline is not having its bid permitted limit, more if it is not parking this year too. With CAM getting supplemental charters programs through June 1964, the contract results have started getting present value expenses as charters.



In aircraft parts, as in men, cumulative stress accelerates the aging process. And stress aging per hour varies for each aircraft. Yet the present way of determining servicing schedules is based primarily on hours flown. In New Douglas researchmen have developed a device which, when installed on an aircraft, provides a more positive method of determining check-up times for aircraft parts. Called a "Service Meter," and weighing less than 150 pounds, the Douglas unit recognizes the acceleration encountered by its aircraft in relation both to number and severity. It allows servicing to be performed on the basis of the true wear age of parts, and will be an important aid to maintenance procedures that keep aircraft young. Research like the foregoing has helped build the Douglas reputation for producing the world's most reliable aircraft.

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## Airline Traffic—February, 1963

|                                    | Revenue<br>Passenger<br>Miles<br>(RPM) | Operating<br>Passenger<br>Miles<br>(OPM) | Enroute<br>Passenger<br>Miles<br>(EPM) | Enroute<br>Passenger<br>Miles<br>(EPM) | Total<br>Enroute<br>Passenger<br>Miles<br>(TEPM) | Average<br>Overnight<br>Load<br>(TON) | Scheduled<br>Aircraft<br>(SAC) | Performance<br>Factor<br>(%) |
|------------------------------------|--|--|--|--|--|---------------------------------------|--------------------------------|------------------------------|
| <b>DOMESTIC TRAFFIC</b>            |  |  |  |  |  |                                       |                                |                              |
| American                           | 5,695                                  | 343                                      | 141,109                                | 20                                     | 141,129  | 3.8                                   | 8,555                          | 87.1                         |
| Boeing                             | 3,272                                  | 145                                      | 71,453                                 | 30                                     | 71,483   | 4.1                                   | 2,237                          | 86.5                         |
| Continental                        | 1,898                                  | 108                                      | 29,093                                 | 43                                     | 29,136   | 4.3                                   | 2,213                          | 86.5                         |
| Delta                              | 4,719                                  | 340                                      | 234,207                                | 38                                     | 234,245  | 3.8                                   | 4,510                          | 91.0                         |
| Eastern                            | 6,523                                  | 478                                      | 305,001                                | 40                                     | 305,041  | 4.3                                   | 6,449                          | 93.5                         |
| Northwest                          | 2,407                                  | 176                                      | 143,891                                | 34                                     | 144,035  | 4.3                                   | 2,474                          | 84.8                         |
| Southwest                          | 1,544                                  | 110                                      | 76,176                                 | 43                                     | 76,219   | 3.1                                   | 1,400                          | 93.0                         |
| Texas World                        | 2,408                                  | 143                                      | 104,492                                | 44                                     | 104,635  | 4.4                                   | 2,147                          | 86.5                         |
| Trans World                        | 4,172                                  | 243                                      | 233,176                                | 44                                     | 233,463  | 5.9                                   | 2,024                          | 89.0                         |
| United                             | 10,253                                 | 754                                      | 506,193                                | 47                                     | 506,240  | 4.8                                   | 13,226                         | 89.0                         |
| Western                            | 1,472                                  | 94                                       | 64,152                                 | 31                                     | 64,183   | 4.4                                   | 1,414                          | 89.7                         |
| <b>Domestic Total</b>              | <b>41,706</b>                          | <b>3,642</b>                             | <b>2,406,910</b>                       | <b>497</b>                             | <b>2,407,407</b>                                 | <b>3.9</b>                            | <b>38,972</b>                  | <b>92.5</b>                  |
| <b>INTERNATIONAL</b>               |  |  |  |  |  |                                       |                                |                              |
| American                           | 148                                    | 51                                       | 12,555                                 | 61                                     | 12,616   | 10.9                                  | 147                            | 100.0                        |
| Boeing                             | 359                                    | 106                                      | 10,415                                 | 23                                     | 10,438   | 4.3                                   | 244                            | 90.5                         |
| Continental                        | 138                                    | 27                                       | 4,449                                  | 14                                     | 4,463  | 9.9                                   | 135                            | 99.0                         |
| Delta                              | 305                                    | 8  | 3,768                                  | 36                                     | 3,804  | 4.4                                   | 181                            | 100.0                        |
| Eastern                            | 766                                    | 43                                       | 63,020                                 | 36                                     | 63,056   | 7.0                                   | 647                            | 94.4                         |
| Northwest                          | 74                                     | 9  | 1,440                                  | 37                                     | 1,449  | 3.0                                   | 71                             | 99.3                         |
| Southwest                          | 318                                    | 56                                       | 44,143                                 | 36                                     | 44,179   | 8.4                                   | 272                            | 90.5                         |
| Trans World                        | 304                                    | 16                                       | 17,718                                 | 61                                     | 17,779   | 4.3                                   | 298                            | 89.8                         |
| United                             | 9,223                                  | 11                                       | 495,362                                | 43                                     | 495,373  | 11.1                                  | 7,916                          | 99.9                         |
| Western                            | 220                                    | 10                                       | 25,792                                 | 43                                     | 25,802   | 10.4                                  | 177                            | 100.0                        |
| <b>International Total</b>         | <b>13,506</b>                          | <b>287</b>                               | <b>230,886</b>                         | <b>431</b>                             | <b>231,117</b>                                   | <b>8.6</b>                            | <b>16,181</b>                  | <b>99.4</b>                  |
| <b>LOCAL SERVICE</b>               |  |  |  |  |  |                                       |                                |                              |
| Allegheny                          | 820                                    | 72                                       | 16,748                                 | 28                                     | 16,820   | 1.9                                   | 684                            | 85.1                         |
| Allegheny                          | 462                                    | 40                                       | 10,744                                 | 19                                     | 10,763   | 2.5                                   | 464                            | 88.9                         |
| Continental                        | 344                                    | 24                                       | 9,734                                  | 10                                     | 9,744  | 3.3                                   | 343                            | 98.8                         |
| Frontier                           | 892                                    | 24                                       | 9,411                                  | 24                                     | 9,435  | 1.1                                   | 893                            | 99.8                         |
| Louis Central                      | 616                                    | 54                                       | 12,318                                 | 17                                     | 12,335   | 1.7                                   | 616                            | 99.8                         |
| Midwest                            | 638                                    | 40                                       | 16,410                                 | 48                                     | 16,458   | 3.0                                   | 634                            | 92.0                         |
| North Central                      | 1,340                                  | 79                                       | 12,643                                 | 27                                     | 12,670   | 3.2                                   | 1,119                          | 99.5                         |
| Qwest                              | 702                                    | 48                                       | 10,407                                 | 14                                     | 10,421   | 1.4                                   | 702                            | 99.8                         |
| Rocky                              | 402                                    | 36                                       | 7,919                                  | 47                                     | 7,966  | 2.0                                   | 402                            | 98.8                         |
| Southwest                          | 801                                    | 50                                       | 11,340                                 | 27                                     | 11,367   | 1.2                                   | 848                            | 94.4                         |
| Southwest                          | 712                                    | 37                                       | 4,813                                  | 13                                     | 4,826  | 1.0                                   | 712                            | 99.8                         |
| Texas World                        | 615                                    | 30                                       | 4,899                                  | 36                                     | 4,935  | 1.2                                   | 603                            | 98.3                         |
| West Coast                         | 219                                    | 10                                       | 4,891                                  | 26                                     | 4,901  | 1.2                                   | 243                            | 94.8                         |
| <b>Local Service Total</b>         | <b>6,136</b>                           | <b>487</b>                               | <b>126,965</b>                         | <b>49</b>                              | <b>127,014</b>                                   | <b>1.4</b>                            | <b>5,203</b>                   | <b>98.8</b>                  |
| <b>ALASKA &amp; HAWAIIAN</b>       |  |  |  |  |  |                                       |                                |                              |
| Alaska Airlines                    | 110                                    | 4  | 5,467                                  | 10                                     | 5,471  | 5.9                                   | 119                            | 85.3                         |
| Alaska Central                     | 109                                    | 0  | 219                                    | 20                                     | 219  | 6.4                                   | 84                             | 88.4                         |
| Alaska                             | 120                                    | 33                                       | 3,671                                  | 41                                     | 3,712  | 1.7                                   | 147                            | 97.8                         |
| Continental                        | 48                                     | 2  | 2,518                                  | 40                                     | 2,520  | 1.2                                   | 24                             | 90.2                         |
| Northwest                          | 392                                    | 30                                       | 5,915                                  | 16                                     | 5,931  | 3.6                                   | 392                            | 99.7                         |
| Rocky                              | 12                                     | 1  | 33                                     | 34                                     | 35   | 0.3                                   | 11                             | 97.3                         |
| San Francisco                      | 110                                    | 3  | 3,497                                  | 13                                     | 3,510  | 1.3                                   | 110                            | 99.8                         |
| San Francisco                      | 304                                    | 8  | 4,074                                  | 23                                     | 4,097  | 4.2                                   | 303                            | 94.7                         |
| Southwest                          | 68                                     | 1  | 674                                    | 20                                     | 675  | 1.7                                   | 73                             | 80.3                         |
| Western Alaska                     | 19                                     | 1  | 14                                     | 17                                     | 18   | 0.7                                   | 13                             | 97.7                         |
| Winn Alaska                        | 246                                    | 3  | 798                                    | 18                                     | 801  | 2.7                                   | 118                            | 92.7                         |
| <b>Alaska &amp; Hawaiian Total</b> | <b>1,000</b>                           | <b>88</b>                                | <b>21,851</b>                          | <b>13</b>                              | <b>21,864</b>                                    | <b>2.7</b>                            | <b>1,093</b>                   | <b>91.7</b>                  |
| <b>NAACOPTICS</b>                  |  |  |  |  |  |                                       |                                |                              |
| Chicago                            | 38                                     | 0  | 66                                     | 13                                     | 79   | 0.3                                   | 38                             | 94.0                         |
| San Antonio                        | 44                                     | 0  | 310                                    | 39                                     | 354  | 0.4                                   | 44                             | 99.7                         |
| New York                           | 37                                     | 17                                       | 385                                    | 43                                     | 422  | 1.0                                   | 43                             | 78.7                         |
| <b>NAACOPTICS Total</b>            | <b>109</b>                             | <b>17</b>                                | <b>761</b>                             | <b>95</b>                              | <b>853</b>                                       | <b>0.7</b>                            | <b>130</b>                     | <b>93.8</b>                  |
| <b>CAT &amp; GATES</b>             |  |  |  |  |  |                                       |                                |                              |
| American                           | 34                                     | 0  | 210                                    | 10                                     | 220  | 1.3                                   | 3                              | 91.5                         |
| Boeing                             | 113                                    | 0  | 7,190                                  | 44                                     | 7,234  | 19.5                                  | 430                            | 91.8                         |
| Delta                              | 767                                    | 0  | 9,133                                  | 13                                     | 9,146  | 8.7                                   | 113                            | 92.7                         |
| Eastern                            | 811                                    | 0  | 12,647                                 | 17                                     | 12,664   | 14.4                                  | 384                            | 90.3                         |
| South                              | 411                                    | 0  | 2,140                                  | 31                                     | 2,171  | 19.8                                  | 131                            | 98.7                         |
| <b>CAT &amp; GATES Total</b>       | <b>2,726</b>                           | <b>0</b>                                 | <b>37,140</b>                          | <b>85</b>                              | <b>37,140</b>                                    | <b>11.6</b>                           | <b>1,051</b>                   | <b>92.3</b>                  |
| <b>Industry Total</b>              | <b>52,623</b>                          | <b>4,416</b>                             | <b>3,136,314</b>                       | <b>10</b>                              | <b>3,140,730</b>                                 | <b>3.9</b>                            | <b>41,891</b>                  | <b>92.9</b>                  |

Source: by Ray B. Lee



# ROLLS-ROYCE WORLD-WIDE SERVICE

Over 250 Rolls-Royce service engineers are stationed with airlines, air forces and aircraft constructors throughout the world to give on-the-spot advice to customers. And 21 companies and airlines are engaged in the overhaul of Rolls-Royce turbine engines in 21 countries. In addition Rolls-Royce aero engine schools provide courses for the executives, pilots and engineering staffs of all customers. ■ Rolls-Royce has more civil turbine engines in service throughout the world than any other aero-engine manufacturer. ■ Over 110 airlines and 120 other operators in 60 countries have ordered these engines, while so far more than 70 customers have placed 140 in-orders covering more than 400 aircraft. ■ No other manufacturer can equal this outstanding achievement! No other can equal the world-wide service built up to support the operation of Rolls-Royce turbine engines.

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1. The Philippines — working on a Dart propeller for a Viscount of Philippine Air Lines

2. Rhodesia — completing new Central African Airways and a Rolls-Royce service engineer examining a Dart on the island of the Victoria

3. Liberia — an Avon turboprop being prepared for installation in a United States Airlines Comet

4. India — a Rolls-Royce service engineer working in the engine department of a Conway bypass jet in an Air India Comet 300

5. U.S.A. — a Rolls-Royce service engineer also examines the servicing of an Avon turboprop in a United Air Lines Constellation

6. Australia — an Avon A.R. 19 engine and a Rolls-Royce service engineer discuss a Dart propeller in a Viscount

7. Italy — a Rolls-Royce service engineer discusses the servicing of a Conway bypass jet in a Douglas DC-4 of Alitalia



## AIRLINE OBSERVER

►Watch for the Civil Aeronautics Board to tighten requirements for approval of professional line experiments. Current Board investigation of such cases is being hampered by lack of detailed information from airlines. CAB may require insurance that airlines will furnish more adequate details on results of line experiments before approving their use.

►CAB also has adopted a new policy designed to eliminate advertising of new promotional fares before they are approved. This would mean the fares known contained by airlines and the conditions and advance requirements when such plans are requested. CAB said it will attempt to issue a ruling within 15 days of the fare's effective date, provided the airlines file their applications at least 45 days before that date.

►Resumption of United Arab Airlines' intention to become a chosen airline for civil aviation in the Arab world may be one of the first projects to be made by the new United Arab Republic, comprised of Egypt, Syria and Iraq. UAA has the sole long-range routes among the three countries in addition to a fleet of seven de Havilland Comets, traffic rights into New York and one of the Middle East's busiest airports and maintenance bases under construction at Cairo, informed observers point out.

►Boeing International Airways is sponsoring a three-week tour of U.S. travel agents through South America to promote travel in that country. The routes will connect about 1,000 travel leaders in 10 South American cities and expose them to private visits to the U.S. as part of the itinerary for trips to Europe or the Orient.

►Federal Aviation Agency is studying the possibility of reducing routine maintenance schedules on VOR (very high frequency omnidirectional radio) navigational aids to lower operational costs and improve schedules. Initial studies have indicated that new work, and FAA will begin a 12-month pilot study May 1 on 147 routine VORs located in low-traffic density areas. Periodic maintenance will be reduced to 115 units and eliminated on 32. Operation of these test VORs will later be compared against 600 other units that will remain under the present maintenance schedule.

►Delta Air Lines will add insurers, the Dominican Republic and Haiti to its present Caribbean/Puerto Rico service on Nov. 1. Granting of a free-air operating authority by the Justice Air Transport Licensing Authority culminated 14 years of effort to secure these points.

►Elizabethtown Airlines' operating revenue increased 27% last year, compared with 1961. Under management by Trans World Airlines, the Athens carrier earned operating revenues of \$13.1 million last year and \$6.2 million the previous year. Passengers received increased 16% and air mail 114%.

►British Overseas Airways Corp. flight engineers and navigators will retire at age 55 under terms of an agreement involving government approval. Improved pension plan will also provide a retirement pension equivalent to half pay after 25 years' service. Members presently unable to reach the 25-year pension limit will be permitted to fly until the present maximum retirement age of 60.

►Air France will provide a weekly schedule of 58 combined jet flights between Paris and the U.S. this summer, including 28 nonstop flights from New York. Five flights will originate in Chicago, two nonstop and three stopping at Miami. The airline will also add a weekly nonstop jet flight from Los Angeles to Paris. Flying time for the 5,602-mile jet will be 33 to 35 hrs.

►Aeroflot Tu-144 turbojet transport jet made its first nonstop Moscow-to-Dallas run after an unannounced three-week delay. On May 25, the Soviet aircraft crossed the earth in about 6 hrs., according to Soviet reports. Current Aeroflot schedule calls for one round trip a week on the route. The Tu-144 has replaced the Il-62, which required about 12 hrs. and a stop at Tashkent on the Moscow-Dallas route.

## SHORTLINES

►Bonanza Air Lines reached a system average load factor of 61.4% last month to attain a first quarter average of 55.9%, compared with 55.0% for the same quarter of last year. First quarter available seat miles increased 27%.

►Bozell International Airways is extending its round-trip group discount fares to Mexico City through the price ceiling (two) months this year. The fares, now in effect from April through November, provide a 25% discount to groups of 25 or more persons, with departures from Dallas or Chicago.

►Continental Air Lines' March traffic increased 20% over that of the same month last year. During March and April of this year, the airline has been operating 6.2 million daily seat miles for an increase of 16% over the same 1962 period.

►Eastern Air Lines plans to offer its first daily jet service between Washington, D.C., and Mexico City on Apr. 25. Daily service will be provided by an afternoon Douglas DC-8 flight from the new Dallas International Airport.

►Flying Tiger Line has moved its air cargo operations from Lockheed Air Terminal, Burbank, to the Los Angeles International Airport. The company's general offices and cargo maintenance facilities will remain at Burbank.

►North Central Airlines recorded a 21% gain in air freight this February, compared with the same month of last year. Total freight ton miles were up 43.7% for the month.

►Northwest Orient Airlines will offer special reduced fares for groups of 10 or more persons on flights to Anchorage, Alaska, effective Apr. 25. New fares will cut \$42 from the present round-trip group fare between Seattle/Tacoma and Anchorage. Special fare will also be extended beyond Anchorage to a group of Alaskan sport fishing camps in conjunction with Northern Consolidated Airlines.

►Pan American World Airways will reorganize direct air service to Mexico Apr. 25 with a seven-week schedule. Flights will proceed from New York to London, then to Beirut, capital of Morocco. Flights will continue from Beirut to Moroccan and Algerian.

►Trans-Texas Airways is paying its fifth consecutive dividend to shareholders. Directors voted a 7% per cent per share dividend payable on or before May 1.



Who'd have thought a 14-track 300 KC recorder could fit into a case this small?

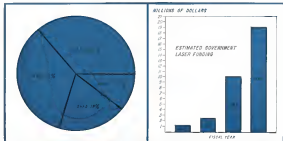
AMPEX

Here is the portable recorder you've been waiting for: the new Ampex FR 1300. It offers all the performance, all the reliability of much larger rack-mounted instrumentation recorders. Yet it fits into a portable case only 24 inches tall. In fact, it's so compact and lightweight that you'll find yourself bawling it like any standard piece of laboratory or test equipment, moving it from job to job or lab to lab. And just look at all you get: 14 tracks! Direct recording in 300 KC with phase equalization, FM recording in 20 KC, an



electrically selected speeds from 1 1/4 to 60 ips, and all solid-state modular electronics throughout, all packaged in one portable case. The FR 1300 also features a built-in capacitor sense system to guarantee accurate tape speeds, without the need for an accessory motor drive amplifier. For more details write the only company providing recorders, tape and memory devices for every application. Ampex Corporation, 834 Charter Street, Redwood City, California. Worldwide sales, service.

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ANTICIPATED MILITARY SPENDING OF \$19 billion in Fiscal 1983 laser research and development is shown left in divided among ARPA and services. USAF may account for the exceeding budget. Figures include government release work, but NASA launch defense under \$5 million are omitted. Aerospace Work & Space Technology estimates right, of government laser R&D funding for laser research fiscal years show sharp rise prompted by possible military and aerospace applications. Fiscal 1984 was first year of government funding and your first defense was reported. Estimates do not include work performed under large technology contracts.

## Aerospace, Military Laser Uses Explored

By Barry Miller

Laser research for a wide variety of potential aerospace and military roles will be expanded during the next year as the explosion of government-supported research and development in this field begins to shift perceptibly toward specific applications.

National Aeronautics and Space Administration and the various military agencies will be conducting feasibility demonstrations in the near future to investigate laser uses in key aerospace and military roles.

In addition, an expanded range of applications and a more intensive effort to probe applications now under investigation are planned in new theoretical and applied research programs being awarded by government agencies to laboratories throughout the country.

Because of the laser's enormous military potential, Defense Dept. is averaging virtually all government defense laser research and is cognizant of needs that is happening in private industry.

Ministry of DOD's interest in this field is that research progress as certain technology originating with a particular service may be reported first directly to the office of the director of defense research and engineering (DDRE).

Research and development in this area as existing fields of interest are watched in closely as a laser activity. All industrial industries (especially seeking defense funding for laser work, as well as those selected proposals not

Advanced Research Projects Agency—\$16 million

NASA—Less than \$1 million

Let alone funding awarded by the Federal Government, was one about \$1 million over the budget for the year, rising as final support for lasers to \$12 million.

There are strong indications that government funding of lasers will increase again during the next fiscal year. What has become a virtual annual deluge of laser proposal requests from military agencies extending from December through early spring, is now being received the year round. Much of this will be covered under Fiscal 1983 funds, but a large portion is probably intended for next year. In addition, many programs submitted by and on research into and beyond defense will be included, perhaps at higher levels as technology progresses appear.

One of the most significant areas of laser research and development, such as a battlefield range finder, which would be practical at the present, could move into production, if not for U.S. then for NATO allies.

Among the specific possible laser applications, some have immediate value, others, now under contract or planned for funding this year as:

- **Range-finding** from earth off both coasts, the red non-cooperative space targets, with its earth satellites.

- Tracking and attitude determination of missile launch vehicles during powered phases of flight.
- Re-entry communications.
- Spaceborne altimetry.
- Doppler optical navigation.
- Air, space, ground-based surveillance.
- Air and spaceborne fire control.
- Battlefield image leaders, battlefield illumination.
- Optical data processing.
- Unmanned surveillance.
- Radiation weapons.
- Warning.
- Secure communications.
- Displays, data processing and recording.

A number of specific programs are needed to investigate, test or evaluate the preceding applications are:

- **546 Polar Laser-based Satellite Tracking**—NASA's polar-orbiting satellite, SIO, to be launched this month from the Pacific Missile Range is to be used cooperatively in an experiment for determining range-only measurements with a pulsed ruby laser system supplied by General Electric's Space Technology Center under \$100,000 contract from NASA (AW No. 15, p. 37). The satellite will be equipped with a pair of 100 optical corner cube reflectors, also in corner reflectors employed in cooperative ranges for reflecting infrared solar energy. Cubes are 5 in. across.

As the satellite passes within range (1,000 km.), a laser spotter, at Wallops Island will beam its red light off the satellite and the return will trigger a photodetector detector. Timing errors are expected to indicate satellite range to an accuracy of 10 ft.

Recently, field tests of the system were conducted (AW Apr. 1, p. 21) at Wallops to check out the system against an aircraft carrying a corner cube reflector panel between the which of its landing gear. To simulate actual flight conditions, the laser beam output was attenuated and the return reflector panel size was reduced to only 4 in. x 5 cubes. The return measurements ranged off the aircraft at a 20,000 ft. range, from which a 75 ft. extrapolation in range suggests the beam for successful ranging against the actual satellite.

• **Cloudcraft Satellite Synchronization**—Some what more complicated ranging experiments using Air Force polar-orbiting Daedalus satellites as targets will be conducted by the Air Force using a cloudcraft optical corner-cube and optical telescope receiving system (AW Jan. 15, 1982, p. 92) being developed jointly by Technical Research Group, Sonoma, N.Y., and American Aerospace, Monterey, Calif., under USAF-sponsored Satellite Data contract totaling \$2.5 million.

To be located on a mountain peak at Cloudcraft in southern New Mexico a few miles from the spot where the first atom bomb was exploded, the



**OPTICAL MASER** ranging and telescope system being built at Cloudcraft, N. M., on edge of White Sands Missile Range will range off non-cooperative space targets such as USAF Daedalus satellites shown in orbit's concept. Cloudcraft system will be tested for future USAF laser space applications. Light beam from ruby laser will range off partially reflective targets over 100 mi. away. Cloudcraft system will be required to pick up about one billionth the light energy received by NASA's S-46 system.



**OPTICAL SUPERHETERODYNE** receiver experiment is part of investigation of heterodyne detection in optical communications program conducted by Technical Research Group for USAF. Optical heterodyning detectors may be most useful for long-range applications where frequency signal might otherwise be obscured in noise. The concept uses

Switch-engine for Gemini:  
another job for Agena



In mid-1965, two astronauts—shown above in their Gemini capsule—will inch forward to dock with an Agena satellite. Project Gemini, sponsored by the National Aeronautics and Space Administration, promises a giant forward stride for the Man-in-Space program by using existing boosters to put separate components on orbit, there to be linked for the mission. The Lockheed-built Air Force Agena—now used in a wide variety of USAF and NASA programs—was chosen for Project Gemini because of the reliability and accuracy it has repeatedly demonstrated. The production-line Agena, so readily adaptable to a wide range of payloads, is giving maximum results for every space dollar.

**Lockheed**

Lockheed Missile & Space Company, Sunnyvale, California • A Group Division of Lockheed Aircraft Corporation

### Government Funded Optical Maser

[illegible]

### And Related Programs in Fiscal '63

[illegible]

# Superpowered Raytheon laser pierces steel girder with light beam

A remarkable new source of energy—the laser light amplification system—has been introduced by Raytheon to project a beam of concentrated light so powerful that it actually can burn a hole through 30" structural steel in one-tenth of a second.

This new superpowered light amplifier drives a solid-state laser through the coherent light beam used by the Raytheon MIT acoustic beam for years to bounce

a shaft of light from earth to the moon and back again.

The continuing study of laser light and its laser energy at Raytheon's Laser Advanced Development Center promises new uses in communications, radar, imagery, space vehicle guidance, manufacturing, and in other civil and defense areas. Raytheon Company, Lexington, Massachusetts.

**RAYTHEON**



## Gamma Ray Maser

Study to investigate the feasibility of generating coherent energy in the gamma ray region with a gamma ray maser based on the Mandelstam effect will be awarded this year by Air Force's Aeronautical Systems Div.

The Mandelstam effect involves selective absorption of gamma radiation in a crystal closely resembling the source of radiation. A maser device operating in the gamma region would have substantially higher information-handling ability than the laser and could concentrate greater energy than the laser.

USAF's study is to explore problems of achieving mass action of these wave lengths. Should the investigation reveal feasibility of the device, the contractor will design an experiment to demonstrate and achieve amplification of gamma rays.

Cloudcraft ranging system is believed to be required to cover an area of 500 ft square at a range of 100 mi. to a resolution of 10 ft square.

In tracking system will have only a 100 ft resolution of transmitted energy returned to it by non-cooperative targets of the type Air Force would be interested in. Essentially, the maser will be required to pick up and distinguish a target from only a billionth the energy available to the receiver of the S-46 system. The Cloudcraft system is expected to provide an excellent testbed for investigation of future Air Force space applications of laser beams that will operate from a telescope and only emit into the desert at Cloudcraft, roughly 5,000 ft above sea level where atmospheric fog, rain and cloud cover are at a minimum.

## System Components

Physically, the system will consist of a laser transmitter, 40-m tracking telescope and receiver, a pair of 15-m auxiliary visual acquisition tracking telescopes mounted with the laser telescope on a precision tripod. Last year, Westinghouse developed an optical radar matrix receiver for use with the system. The laser's extremely narrow beam width offers high resolution and precise tracking.

**• Missile Altitude Determination:** Active determination of missile altitude during powered phase by observing changes in the direction of polarization of the light beam transmitted by a laser on the ground and reflected from optical optics on the boost vehicle will be investigated by Radio Corp. of America in a new contract from USAF's Electronic Systems Div.

**• Integrated Optical Tracking:** Integrating active (laser radar) and passive

(infrared or altimeter detected) optical techniques into a single system capable of passive detecting and acquiring a target and then tracking it with laser radar will be the subject of a two-year effort ASD is contemplating. Because of its extremely narrow beam width, laser acquisition is very well suited for a laser tracking system, which more conventional infrared/altimeter detection systems are built on. During its two-year development period, this program will cost over \$0.5 million and is expected to result in a feasibility study to be flight tested in a modern performance aircraft and used for detecting and tracking ballistic missile launches.

**• Altitude Senses:** Feasibility of using the laser as a laser altimeter for determining altitude and closure rate is being investigated by Radio Corp. of America's Defense Electronics Products Div. for ASD under a \$200,000 contract.

**• Spaceborne Doppler Optical Navigation:** Program to demonstrate the feasibility of non-cooperative laser ranging capable of determining ground speed with an accuracy of 1 meter/sec from an altitude of 300 mi. is about to begin under USAF/ASD sponsorship. A laser Doppler radar has some advantages over microwave Doppler because of the smaller beam width of laser radiation which will provide more narrow band spectral returns. Both AM and FM modulation techniques are to be explored. The program now has about \$100,000 funding in fiscal year 1972 that is unusual use with completion scheduled for early 1975.

**• Re-entry Communications:** Use of a laser communications system aboard a re-entry space vehicle would offer a superior solution to the problem of radio blackout caused by ionized gases (plasma) surrounding reentering space vehicles. This will be investigated later this year under Air Force contract, probably covering from ASD and running about \$110,000. Engineers at Douglas Aircraft have demonstrated that, as expected, the red light (R-914) of a new laser will penetrate re-entry plasmas (AW Feb. 21, p. 97).

**• Precision Induced Tracking (PIRT) System:** One of the largest single laser contracts ever awarded for a precision tracking laser system to electronic acquisition, reliability and position of a boost vehicle throughout its powered phase by continuous wave techniques was awarded recently, apparently the winner of a competition in responsibility for the contract within the Force. Radio Corp. Development Center (RADCO) now has responsibility for this program, previously administered by Patrick Air Force Base. Patrick Elmer says it had contributed knowledge of the system before the S-1

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### Laser Funding

As Fico accounts for the largest single portion, approximately 30%, of U.S. military spending in the fast developing field of optical sensors. If a budget shift to spend about \$5.5 billion on its study and on laser applied sensors research and development during Fiscal 1967, an increase of \$1.1 million over the \$4.4 billion USAF laser funding level of Fiscal 1962.

Should all the programs USAF is now planning for the remainder of the fiscal year authorize, an additional \$1.5 million may be required to cover necessary costs.

All nine programs selected initially under the many USAF optical sensor program for which funds have been spent are estimated for both Fiscal 1963 and 1964, are expected to get in several more during Fiscal 1964, those will amount at the time level. This could suggest a rise in the laser funding in Fiscal 1964. The new program selected amount for \$1.12 million in 1963, are expected to account for \$1.75 million in 1964.

National Aeronautics and Space Administration's activity in optical sensors is put beginning last year, with the help of its subcommittee provided by Radio Corp. of America, General Electric, Philips and Hughes Aircraft.

Lincoln Laboratory of Massachusetts Institute of Technology, which is a key communications contractor in the National Spaceborne Center in performing extensive laser development support for NASA.

million program was transferred.

• **Guidance Surveillance—Possibility of developing laser in the Navy program at the visible spectrum, in which wavelengths will be in the low atmospheric data at other frequencies, it being permitted by the Navy as the hope of using the high possible power associated in the laser's narrow beam in new weapons devices and using existing Radio Corp. of America in Washington, Mass., and Radio Shack contract of \$148,877 to research, develop and test a blue-green laser and to explore its application. The company has a separate Navy contract to investigate transmission of laser beams in sea water. Recently, the Laser Systems Center of Lear Siegler generated a green beam (5160 Å), the usual laser output of a semiconductor diode laser output moved in a nonlinear crystal.**

Recent trends of the output was about a milliwatt, output pulses less than 100 nanoseconds.

• **Radioactive-Powered Laser Radar—Possibility of detecting passing a laser with alpha, beta, gamma or neutron**

sources, thereby providing the efficiency, long-life and light weight needed for airborne and space laser systems. Laser studies in the last studied under a forthcoming program, \$100,000 or less, from ASD. A 15-year effort, the program will be aimed at evolving a self-contained solar package, battery, power supply, modulator, transmitter, pulse shaping and timing circuits.

• **Airborne Space Surveillance—Several efforts in airborne space surveillance for which the laser was actively being studied, because of its potential high angular resolution, low power is quantities and light weight are being pursued by government contractors. General Precision Laboratories recently completed an analytical study of various laser communication system and in phase two of the program, for which studies proposals are being evaluated by ASD operating laboratory equipment will be built. Electro-Optical Systems has been at work on optical waveguide components and techniques over the past year and a half under RADIC contracts totaling nearly \$1 million. It is developing variable phase shifters, power dividers, attenuators and beam steering techniques. Its goal is a laser CW oscillator pulsed amplifier and laser heterodyne all operated on common compatible optical line.**

• **High Resolution Recording—Techniques for scanning and storing photographic images, which might have wider scanning range than a cathode ray tube, will be investigated by North American's Space Information Systems Div. in a forthcoming government program. The laser beam will scan a raster on photographic material. Simplicity of setup will be one important possible virtue of the technique, according to the company.**

• **Optical Computer—Possibility of reducing ultra-high processing rates by using semiconductor as optical filter, then in getting correct medium and volume, according to American Optical working under a \$30,000 RADIC contract, has demonstrated "no" operation in a laser. RCA is continuing its research laser logic work (AW Feb. 8, p. 42; Oct. 12, p. 71) under RADIC contract. Air Force is evaluating industry proposals for a contribution of American Optical's work in developing glass fiber laser for digital data processing.**

• **Ballfield Range Finder—Several aerospace companies have demonstrated pulsed ruby laser range finders which may be superior in ranging devices available for field army use. Radio Corp. of America has been working on possible range finding capability at propagating tanks, helicopters, light aircraft, personnel carriers and other targets**

(AW Feb. 8, p. 43). Hughes has developed a 44-ft laser range finder (AW Mar. 13, p. 31) that can range to an accuracy of 5 in. at 7 mi. distance and beyond 5,000 yd in inclement weather. A number of American companies are trying to sell, here and abroad, laser range finders which combine one of the most accurate and reliable laser applications as they do not require more complicated radar processing techniques and components.

• **Display—Use of laser as tools in developing optical output devices such as displays, scale displays, communication and data printers is being investigated by International Business Machines under an eight-month, \$52,688 Army Signal Corps contract.**

• **Welding—Laser welding systems, capable of joining materials such as Rene 41, Ti-6Al-4V, and D13 collaboration of thicknesses of at least 25 mils by direct laser welding and up to 125 mils by using a V-groove, is being built by Technological Research Group under \$214,814 ASD contract. When it is completed this June, Grumman Aircraft Engineering Corp. will test the metallurgical quality of the welds, run an experiment to test period. ASD regards laser welding as a promising joining technique, complementary to electron beam welding. Unlike electron beam welding, the laser technique probably will be limited to thin thickness materials but welding can be done at atmospheric pressure. Taking advantage of the extremely high power density outputs from a laser often pulsed, laser welders may concentrate heat energy per unit area than any other welding system. The laser can heat and cool metals at rates faster than they ever experienced. TIG has achieved 10 million C/hr. cooling rate with tungsten in one particular experiment. Unless the laser is operated at a rate exceeding 240 pulses per sec, the materials will cool rapidly, solidify by twice pulses. The pulse rate affects in TIG is 100 pulses in 0.1 in. pulse per sec. Weld pulses are shaped into either rectangular or trapezoidal pulses with**



**POWERFUL NEW LASER**, UNB-4, capable of delivering 310 pulses of energy, developed by Raytheon Co., is shown joining a hole through a 1-in. thick steel plate.



shelving designing guiding edges by photo-lithographic methods. This performance network will allow about 50,000 signals and use about two thirds of this, the remaining capacity being lost to delicate manufacturing to serve at desired shapes. Both pump lamp and relay bond are water cooled. Several other components, including Hughes Aircraft and Kinetix, which recently reported achieving several unattended duration points of as much as 900 megawatts, are actively pursuing the industrial laser welding market.

• **Radiation Weapons-Inertial** computer have publicly identified the laser as applicable in the expanding program of ballistic missile defense technology. Scientists regard the present levels of output power and power densities as being satisfactory for applications of order of magnitude below requirements. But the laser case at its present stage of technology may well be close to levels necessary for other types of non-lethal weapons-rich in space-based means of locating, tracking, and neutralizing detection of potentially hostile space vehicles-thus that should be discarded. Since it may take three years for laser impacts to rise to predicted "bounced" force, operations of laser weapons may require for several years. A number of programs possible, applicable for weapons are indicated in the title (see pp. 55-59).

• **Angela Radiation Source**-The traveling wave laser (AWF) Feb. 11, p. 90, developed by Sperry Rand Corp. and widely regarded as the most significant recent laser developments, will be reviewed at a possible collaboration seminar in an upcoming contract open soon to ASD.

NASA is seriously examining several possible spaceborne applications for the laser, particularly the cavity efficient pulsed laser source. Marshall Space Flight Center recently awarded a \$49,000 contract to RCA to develop a semiconductor (gallium arsenide) pump source matched to the laser medium itself. The use of direct diode pumping could simplify laser pumping much means and make the device more powerful for space.

Stanford Research Center is exploring several possible applications. Lincoln Laboratory, in general considered in RF communications, is developing an optical radar system for possible use in space rendezvous navigation or as a laser transmitter for laser altimeter for aircraft. Such a system, it feels, may allow about 100 ft. from sight otherwise required by microwave radar.

As a laser altimeter, laser radar might provide a solution to the altimeter of microwave range by radar altimeter. The interaction of solid beam used for measuring altitude and

velocity data and altimeter altimeter may well be a difficult problem for the Surveyor laser altimeter (AW Oct. 3, p. 11) as it could be for other laser altimeter vehicles whose altimeters operate in radio frequency ranges.

One experiment being investigated by MSC for possible use in one of its manned spacecraft may be a laser-based, close-orbited optical altimeter altimeter which is altimeter sight point toward the ground and then beam a 30-sec. altimeter to the receiver.

Studies of deep space optical communications are being conducted for MSC in Hughes Aircraft under a \$46,449 contract concerned with evaluation of optical communications as a different type of space power. There are laser communications between spacecraft and earth, between spacecraft and in orbit, between spacecraft and in orbit, with autonomous computing, the use of the earth to send information, altimeter and scattering of optical waves, and between spacecraft and laser-based laser station from which point altimeter, provides the computing link to earth. Results to date, according to NASA, point to superiority in performance of point of optical communications over microwave.

The extensive activity directed toward altimeter and altimeter altimeter from should not conceal extensive work in progress on basic and expanded research, earth growth, increasing device efficiency, pump source and non-laser system. There is a major effort devoted to development of components and techniques analogous to those at lower frequencies required for effective applications at optical wavelengths to com-



### Optical Transistor

Optical transistor, new type device in which energy is transferred between particles in form of light, has been developed by IBM Research Center. This new transistor, called a Solid State Modulation Decoupling System, is expected to be able to operate at frequencies in the gigahertz (one billion) range. Part of incoming (output) signal is converted into light, passes through a laser-emitting process, where it is directed, reflecting electron to the collector. Bipolaroid device, have shown power gain of up to 50 at liquid nitrogen temperature (77K).

communications, altimeter, navigation, guidance.

Among current and proposed government research and development programs designed to advance laser technology, bringing it to the point of system applications, are the following:

• **Infrared Pumping Techniques**-Two new \$10,000 ASD programs to analyze direct electric current applied to semiconductor crystal, explosive wires and foils, and other techniques.

• **Basic Systems Considerations**-Studies by several universities for the Air Force relating to optical radar and communications in space. Ohio State is reviewing coherent optical radar parameters, University of Michigan is propagating coherent means of optical spectral region in space communications, University of Denver is exploring laser applications.

• **Frequency Translation Techniques**-SDS sponsored, \$500,000 program to investigate means for obtaining range and range rate from a single laser radar pulse, as expected to culminate in a technology demonstration model for radar and interception.

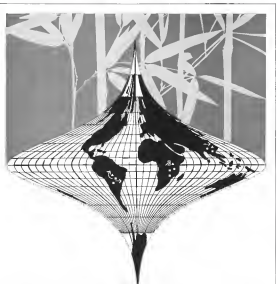
• **Optical Beam Steering**-Study of means for moving, directing and steering extremely narrow beams characteristic of laser outputs (in an accurate phase array), possibly applicable to ground-based surveillance equipment (AW Aug. 8, p. 105) will be performed by Philips Corp. under \$47,250 contract from RADC. Broadband models are scheduled for next year at which time the leading line could use significant. Electro-Optics' laser supported systems are expected to result in a coherent optical laboratory early during Fiscal '64.

• **Thermally Controlled Laser-Air's** Regal Corp. is expected to announce the general of a study of techniques for handling heat dissipation and thermal control of solid-state lasers to permit controlled on-off operation.

• **Optical Coding and Transmission Techniques**-The RADC effort and researches in optical fiber techniques for ultrahigh speed-type transmission of information at optical wavelengths.

• **High CW Power**-Effort to boost by an order of magnitude the present level of one watt CW power from a solid-state laser may be undertaken soon as part of an ASD program. Such an effort could raise approximately 50-150 watts.

• **Solid State Modulation Decoupling System**-Demonstrations of the feasibility of a complete light transmission system with modulators and demodulators for matched with respect to frequency response, light energy, and mode of modulation will be carried out under a forthcoming Army Signal Corps contract. This will create an high-



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The Wire-Form Contact is extremely small, permitting high-density packaging. Depending on the connector insert used, you can have contact centers on 0.100", 0.083", or even down to 0.075". Yet connections are easy to assemble... because you terminate before centers are inserted, while there's still room to maneuver later. If you want to change circuitry or replace a component, contacts can be removed, repositioned, or replaced without discarding the connector.

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nated by crimping, soldering, welding, or wire-wrapping. For single-contact terminations we have stylelet type female contacts that can be potted in modules or soldered into circuit boards.

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The Wire-Form family will help keep costs down. High volume manufacturing methods let Amphphenl market Wire-Forms at unusually low purchase prices. For example, our circular Wire-Form Connectors like Mighty-Mat meet or exceed the performance characteristics of other micro-miniature connectors, adding far less to the price. But initial cost is only half the battle.

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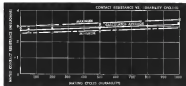
varies less than half a milliohm through a thousand cycles of engagement/disengagement. (See chart below.)

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One of the main reasons things go smoothly about the Wire-Form Group is the way it works as a team. No matter what kind of challenge comes up, at least one member of the Wire-Form team can handle it. This means you only need to stock one basic component, the Wire-Form Contact, to meet virtually all your micro-miniature connection needs. The savings in inventory investment, in stock control, and in uniform manufacturing methods can be substantial.

## FACTS AND FIGURES

The new 24 page catalog on Amphphenl Micro-Miniature Connection (Catalog MM-1) has the facts, figures, drawings and detailed performance characteristics you'll need to "help yourself." You can get a copy by contacting your local Amphphenl Sales Engineer or by writing to Dick Hall, Vice President, Marketing, Amphphenl Connector Division, 1830 S. 54th Avenue, Chicago 50, Illinois.



Tested male contacts were Amphphenl cat. number 20-055, formed from gold clad, metal clad beryllium copper into the female (cat. number 220-025 shell) was copper bodies with electrodeless gold wire metal plating. Both parts were subjected to 1000 mating cycles.



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new information transmission of the type the laser is capable of handling. Modulated bandwidth will be 1 kHz at 10% modulation index under CW operation with the modulator spectral of 3 line bandwidth. Dissolved laser output power goal is  $10^{-6}$  watts (0.1 mW/cm<sup>2</sup>).

• **Frequency Shifting**—Flexibility of shifting laser frequency by as much as 100 Angstroms for possible applications in communications and radar, may be investigated in an ASD program, probably not exceeding \$100,000.

• **Irradiated Laser-Mirrors** Co is considering a specially study to determine the effects on optical aspect of neutron and gamma radiation at several laser controls.

• **Single Mode CW Laser**—Development of a single mode CW laser which can be optically heterodyned at high rates is likely to be started in an ASD program.

• **Signal Control Techniques**—Study of modulation techniques applicable to language recognition radar is an RADC program contemplated for next year.

• **Optical Communications**—Investigation of modulation and coding techniques for optical systems for application in space communications will be considered for National Aeronautics and Space Administration in FY66 under a \$10,000 contract.

• **Resonant Cavity Optical Detection**—Program to experimentally verify

optical heterodyne techniques developed for the detection of modulated laser signals will be placed with under its code by RADC. That is a continuation of work performed by Technical Research Group. Experiments will be on techniques sensitive to random phase variations introduced by the transmitting medium.

• **Non-powered Laser-Air Force** interest in a non-powered laser (AW Dec 5, 1961 p. 92), which would use light energy supplied by the sun to pump an optical laser transmitter to space in contrast. RCA developed a CW, liquid-core cooled colorimetric laser laser last fall and Air Force has two systems supported (S100-000). American Optical research on a similar concept ASD now plans an additional project.

Investigation of optical laser materials for two pumping, a \$100,000 study.

• **Electron Injection Laser**—Cooperative Incoherent Signal Group study planned for later this year.

## Realistic Examination

Despite the broad activity directed toward applications, a few scientists, engineers and people familiar with government laser work, is that too few, serious people have realistically examined applications for the laser. If this is true, we anticipate/make an effort to be expected to spring up as laser technology, itself, some of these now being pursued may well be discarded.

## Optical Maser Background Outlined

Optical masers provide sources of controllable electromagnetic radiation systems widely have divided higher than those previously available with microwave oscillators. Aside from their significance as oscillators or amplifiers in a portion of the frequency spectrum previously developed for active systems for the aviation engineers these devices have potential properties making them suitable for communications and radar like systems, particularly in space.

Remote information capacity is proportional to frequency, devices operating in the optical region, have the advantage through the visible and near infrared, have relatively capacity for communications, allowing existing previously available. Output from the optical maser are highly collimated, permitting focusing of the beam to give extremely high power densities, large enough to vaporize targets in kilometer experiments.

The maser's directional property makes possible communication as a medium such as space over great distances compared with radio systems operating at lower power levels.

Frequently called a laser the light amplification by stimulated emission of radiation, the optical maser was first operated barely three years ago (AW July 15, 1960, p. 64), although its maximum potential particularly in space was known before then (AW Dec. 14, 1959, p. 87).

In the three years since the operation of the first solid state RADC in this field has made great strides. Optical masers have been made to operate at nearly 200 different wavelengths in the visible and infrared regions, employing systems using such as deuterium, glass, semiconductor and plastic liquids and gases. Differences have been reported, however, generation and optical heterodyning have been shown, multi-wavelength pulses are being generated and secure techniques of modulation and demodulation are being explored.



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► **Duglier Navigator Gives Attitude-Laboratory Test Electronics** has developed a technique which will enable its AN/SPN-121 Duglier radar used in the Republic F-105 to function as a radar altimeter. New function is obtained by increasing dead range along forward beam of the Duglier radar which does its altimeter and altimeter path angle. New models of the AN/SPN-121 will incorporate the altimeter function with a weight increase of only 7 lb involved in the addition.

► **Computer Designing Computer**—Increasing industry interest in use of computers to automatically design or optimize the design of digital processing equipment is evidenced by two reports released at recent IEEE convention. Washington, ERM has developed program for an IBM 7094 computer that simulates the function of the truth table of an application circuit into a truth table for the input equations for the members of a machine, to be developed. The result enables the computer designer to select type of computer system which will yield maximum number of logic elements. The technique is part of Westinghouse Air Force program to achieve maximum use of information in the design of new computers. The report developed by H. F. LeGros and H. J. Gresh of Bell Telephone Laboratories told IEEE that additional research effort is required



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► **Spacecraft Power Requirements**—Electric power needs of currently planned military spacecraft are not expected to exceed 5 kw before 1973, according to Robert Hamilton, Institute of Defense Analysis, pointed at a recent Photonic Specialists Conference in Washington. National Aeronautics and Space Administration's W. R. Cherry estimated that Goddard Space Flight Center spacecraft planned for launch between now and 1973 will require less than 1 kw. Advanced photonic packages currently considered are not expected to require more than 2 kw and probably will need less than 1 kw. A. H. Smith of Jet Propulsion Laboratory estimated these figures suggest that solar cells will continue to be major source of electric power as unmanned spacecraft for the coming decade. NASA spokesman said the agency expects its program will require about 1.5 million solar cells per year, while a Defense spokesman estimated its needs at between 100,000 and 200,000 solar cells per year.

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for way needed in extending mechanism into more and more of the design process. The added program already are available for covering out portion of the logic design of digital data processing systems.

► **Detective Chase Sought in Fly's Sense of Smell**—Investigation of the locomotion of small powered fly insects that are capable of discriminating a large number of compounds inaccessible to humans is being conducted by Aerodynamics Division of Ford Motor Co. The study might lead ultimately to photochemical analysis of the insect's olfactory organs for use in detection of toxic gases, chemical and biological warfare agents. Associations involving are working with green bottle flies largely because of the ease in raising these insects. They are removing the olfactory organ and associated nerve attached to it, place them in small chambers into which trace amounts of substances to be tested are inserted. Probes are then attached to the antennal nerve through a negative electrode and amplifier and amplified as an oscilloscope which displays action potential. Nature of the response at the surface of the olfactory organ causing action potential is of prime interest in the investigation.

► **High-Temperature Solar Cell Program**—Extensive growth of films of polycrystalline on gallium arsenide substrates is to be evaluated in an ongoing effort sponsored by NASA's Lewis Research Center as part of a program to explore gallium arsenide solar cells. Industry proposals for the program were submitted last week. Design and fabrication of gallium arsenide solar cells capable of operation at temperatures of 500C will be conducted. Properties of optimal structures to be measured will include mobility, carrier lifetime, carrier lifetime and photon absorption.

► **Signal on the Distant Edge**—Among contracts of interest recently awarded to various companies are:  
 • **Space Technology Laboratories** will conduct additional research on a cryogenic microwave receiver for the Office of Naval Research.  
 • **Cornell Aeronautical Laboratories** will continue its high-power microwave radar research program. Project Delphi, under a contract from the Army, totaling \$90,379.  
 • **Hughes, Dees & McDonald, El Paso, Texas**, will replace vulnerability of missile guidance systems to nuclear damage under contract from Aero's Hines Diamond Laboratories.

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**\*THOROUGHLY TESTED** — More than 25,000 miles of actual low level flight tests and 200,000 miles of computer simulation have proven the system's capability and reliability. In one test an aircraft flew at 400 feet from San Diego, California, to Las Vegas, Nevada, over some of the roughest terrain in the United States without the pilot having touched the controls. Available now, the versatile General Dynamics/Elec-

tronics unit is suitable for manned or automatic guided flying at speeds from 100 knots to well in excess of Mach 2.5.

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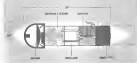
**APPLICATIONS** — Besides adding all-weather, low-level mission capabilities, the system permits safe, automatic in- and out-of-cloud cover to non-estimated air fields. It also protects aircraft flying through unfamiliar mountainous terrain in periods of poor visibility. During any ground-hugging flight the radar system does the pilot to observe or operate navigation and other equipment.

**RELIABILITY** — As a result of simplicity of design the system is highly reliable and requires no absolute minimum of maintenance. This factor is enhanced because there is no moving antenna and no requirement for a radar scope. For further information on Terrain Following Radar, write to Department D 19, General Dynamics/Electronics — San Diego, P.O. Box 127, San Diego 12, California.

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# U.S.-Europe Comsat Agreement Predicted

By Carl Bruesch

Paris-Mayer West European nations, including the United Kingdom and France, are expected to join with the U.S. in a multilateral development and operation of a first-generation global communications satellite system—despite strong submarine "go-it-alone" postures within some political circles.

Tentative decision to join with the U.S. in the communications satellite field has already been made by representatives of at least nine West European nations directly concerned, according to informed sources here.

Further any board action, completion is expected in June, with a final formal plan evolving possibly as early as September.

Other countries known to be involved include West Germany, Italy, Norway, Denmark and Sweden.

Prime impetus to date for such a move has come from officials of the various national defense communications agencies. The reports of these view a communications satellite developed and operated in cooperation with the U.S. as a vehicle with potential for a relatively low profit and an early return on investment.

They contend that assistance upon an all-European system as a first step—either on a national or multinational basis—would only result in a system developed "on line" at too great a cost. Strong objections to their view has been voiced within some foreign ministries.

to, and space agency circles of the major European nations involved. These agencies view space projects as an extension of national prestige and feel that the U.S. should not remain too long as the lone active participant in the West.

At least for the first round, however, the communications satellites field has been given an open hand in most European nations, although they want European nations to play a significant role in any cooperative venture.

Initial agreement, either on a government-government basis or directly with the privately owned U.S. Communications Satellite Corp., probably would cover a 5-6 year period, if the European advocates of cooperation have their way. These officials say that if European participation would be unacceptable politically.

Supporters of that approach also hope that a follow-on agreement can be subsequently arranged—one that would allow for advances within the European space capability that probably will have been made by the time such a pact is consummated.

Follow on cooperation, they contend, possibly could extend to use of European launch systems to put replacement satellites in orbit. It also should at least include provision for shipment of payload packages developed and produced in Europe, they feel, to prevent the Continent to share in the general technological fallout from such a program.

General recommendations to join in the U.S. communications satellite program was voiced by government communications officials from the same European nations here in mid-March, although several had no explicit authorization from their governments to take formal stands on the matter. Those who did, however, reportedly included the delegates from France.

The group, as all had committee formed in December with instructions to study the overall problem, now under the aegis of the Conference of European Postal and Telecommunications Administrations—all government controlled.

They agreed to meet for further discussions in early June. The meeting probably will be convened in London, although the exact site and dates are still under consideration.

As that session, the representatives may have stronger guidelines from their respective governments. A list of questions concerning the technical and political matters involved will be drafted for transmission to the U.S., probably to the Communications Satellite Corp. and the National Aeronautics and Space Administration.

These will include queries on the number of frequencies and channels involved, anticipated uses and the extent to which the European nations could actively participate in development, production and administration.

It is unlikely any to be placed into orbit, for example, Europe would want to build at least two of three under U.S. supervision and under the necessary American technical aid.

The program will be considered again in September at a plenary session of the panel conference.

British communications representatives at the Paris meeting also reportedly endorsed the plan for cooperation with the U.S., and the latest announcement by Minister of Aviation John Aneurin Bevan that the U.K. would conduct its own private communications satellite design program (AW Apr. 8, p. 31) might make European officials less suspicious.

After a second look, however, they point out that any U.S.-European Comsat system is a "delimited study" to determine a suitable design for a communications satellite.

During a House of Commons debate, Aneurin also declared that he was "not at this stage contemplating the development of a communications satellite. What I have announced is the decision to undertake a delimited design study." He added later in the debate:

"In the government's view, we have not yet arrived at the point where we can choose between the different solutions proposed" involving direct cooperation with the U.S. a Comsat study center, a European program, etc. "but Britain still has part in space communications and shall do so not only in the sending and receiving of communications, but in the provision of satellites and in the provision of launchers and parts of launchers."

This stand, officials here point out, appears to be far from a "go-it-alone" decision, and Aneurin concluded in the Commons debate that "while they [the Americans] have experience of space programs generally and of telecommunications in particular, and with the great financial powers they have, we must expect their system to be very attractive to other countries."

Officials recognizing cooperation



## Apollo Adapter and Service Module Tested

Full-scale Apollo spacecraft adapter and service module have been delivered to NASA's Marshall Spaceflight Center, Houston, and their dynamic characteristics tested for structural damping, resonance frequencies and mode shapes. Vibrations were laterally induced by MB Electronics 1,750-horsepower motor at three points on the two systems. Frequencies ranged from 10 to 130 cps during the tests.

With the U.S. also are expected to plan for development of a patch European communications satellite program as it evolved by Rome, a strong West European trade association with a total of 151 industries and banks members (AW Apr. 8, p. 33).

They do agree, however, with the organization's major goal—to gain a share of space for the European aerospace industry in areas technologically beyond those now being advanced by the government-led agencies.

Technological reasons aside, European communications officials believe that cooperation with the U.S. in the telecommunications field is a sensible step because the majority of intercontinental telephone traffic originates or terminates in the North Atlantic countries. A system excluding the U.S. would suffer an annual revenue

Rue Mundy, Great Britain's assistant postmaster general, said recently that the greatest intercontinental telephone traffic totals 2.4 million calls a year, with all but 800,000 of these crossing the Atlantic. The percentage for other areas will increase in the future, Mundy said, but transatlantic traffic by 1960 still will represent approximately 70% of the world total.

French advocates of a cooperative venture with the U.S. contend that with total telephone traffic growing about 30% per year, ground cable and other intercontinental systems "will be beyond the saturation point."

There, however, it is shown, a cooperative communications satellite system operational by 1965-at least two years before an all-European pact could become effective—will provision for about 4,000 telephone channels.



## Dummy Reactor Re-entry Test Scheduled

Atomic Energy Commission reentry flight demonstration (REDF II) next reentry mission, shown here as a mock-up with the fourth stage of the Soviet vehicle, was scheduled for launch last week from Wallops Island, Va. First three stages of Soviet was to carry the 40,400 dummy stage IBA reactor to altitude, and the fourth stage was to drive it into the atmosphere at a velocity of 33,100 ft/sec. Objective was to determine how a reactor core can be disposed to disintegrate on re-entry to eliminate radioactive hazards from space nuclear energy systems. The flight was to carry the package about 500 mi. Two more mock-ups are planned during the next 24 months.

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## Free-Flight Lunar Landing Model Tested

By C. M. Plummer

Wind tunnel studies to evaluate aerodynamic drag and jet engine thrust are few characteristics of a 1/10 scale model of a free-flight lunar landing test vehicle are under way at National Aeronautics and Space Administration's Langley Research Center, Va.

Model was fabricated at NASA's Flight Research Center, Edwards, Calif., which is managing the space agency's free-flight test vehicle (FFTV) program. Wind tunnel data from Langley will be forwarded to Bell Aerosystems Co., Buffalo, N. Y., which is building two full-scale lunar landing research vehicles under a \$5.6-million contract from Flight Research Center (AW Feb. 25, p. 78).

First research vehicle is scheduled for delivery to Bell to Edwards in April, 1968, and the second vehicle two months later. Initial flight is expected in June, 1969.

FFTV is one of three NASA lunar landing dynamic simulators. Others are Ames Research Center's Bell X-14A, now in its test phase at Moffett Field, Calif., and Langley's gravity-type lunar landing research facility (AW Feb. 2, p. 28), which also should be operational by mid-1969.

Designed to simulate techniques for the terminal phase of lunar landing and possible a tethered free-fall, the FFTV will come closest to simulating the final phase of the moon landing. Aerodynamic forces of the Ames X-14A winged aircraft cannot be replicated to simulate thrust supported vehicles with wet aerodynamic surfaces. The gravity of the Langley facility lunar landing approach altitude is 165 ft and horizontal travel is 400 ft.

Each simulator offers certain advantages, however. The cable-supported Langley simulator is safe and can be fired by single technicians. The Ames Research Center's larger customer drive the FFTV. Flight duration of the FFTV is about 10 min.

Four-legged FFTV will simulate lunar gravity conditions. Each of Central Electric C-770-2B tail-jet engines, carrying 4 lb of vehicle weight. The hovering 4 lb of its weight is subject to earth's gravity, and, in effect, simulates lunar gravity conditions.

Jet engine with a maximum thrust of 4,300 lb is attached to the vehicle by a double parallel ring system and can swing through a cone of 40 deg half angle. It is located at the center of gravity, and an automatic deflation system keeps the engine vertically aligned, regardless of vehicle attitude. Thrust control is automatically main-

tained at the proper level in varying altitudes and fuel weights.

Two selected 10-4 tanks, each containing 350 lb of fuel, are located on opposite sides of the vehicle, level with the gyroballast bags. A tunnel fuel tank, originally proposed, has been replaced with the spherical tanks to measure fuel draining.

Design specifications set down by NASA on the overall free-flight weight also require that the weight of the FFTV will not exceed 91% of the engine thrust. This provided Bell with flexibility to optimize engine and vehicle weight.

Over all height of the simulator is 18.7 ft up the top of the engine no down. Flat on level is about 15 ft above ground. Adjacent legs are 21 1/2 ft apart. The framework is constructed of aluminum tubing. Two 4-in. dia. legs and 1-in. dia. horizontal upper frame work around the engine.

First version of the lander will be

single phase configurations but the 4-sq ft platform, which supports the rocket, can be changed to accommodate another pilot. Since the Grossman Lunar Emission Module (LEM) will carry two crewmen, another seat will be added to the FFTV during the test program for evaluating approaches with two occupants.

Three-axis attitude roll similar to that used on North American X-15 will indicate pitch, yaw and roll. Longitudinal and lateral translations also will be indicated on the instrument in vertical and horizontal bar similar to ILS (instrument landing system) needles. Two in. indicated in left or right rotation of the attitude bar and pitch and roll indicators resemble those observed on a standard gyro horizon.

Additional instruments probably will be of the vertical scale type and will measure translational velocity ( $\pm 100$  ft/s), vertical velocity ( $\pm 100$  ft/s) and



WIND TUNNEL MODEL of two flight test vehicle for simulating lunar landing has been prepositioned inside mounted within framework of two legs, body and right hand-pumped. 804 tanks mounted between legs on the lower of the vehicle. Left and right. Tank on foreground and one below on opposite side are ballast provide fuel tank. Black lines on the wind tunnel model represent structural packages. Photograph was taken on the dry lake bed at Edwards.

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#### A TYPICAL SYSTEM

These techniques have been used extensively in the PCM telemetry systems supplied to Bell Brothers Research Corporation by EMR for the NASA S-17 Orbiting Solar Observatory.

Based on conservative predictions of component failure rates, this system has in excess of a 0.66 probability of successful performance for a one-year continuous operating mission in orbit. This reliability is achieved in the three-year system (complete with individual power inverting while consuming less than 1.5 watts of spacecraft power).

The system uses 1561 transistors and provides inputs for 64 subcarrier-analog channels and 39 eight-bit digital channels. The system, packaged for spacecraft installation, occupies 212 cubic inches and weighs only 180 ounces. It has been designed to operate over the spectrum of rigorous satellite environments and has proved its merit during extensive customer testing.

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altitude. A vacuum altimeter measuring altitude up to 100 ft. probably will be added for more precise control during landing.

Jet engine will be controlled by a standard throttle, with an alternate feature, so that the pilot can have full thrust available in case of an emergency. A collective handle will be used to control the lift rockets, expelling descent after the jet engine is set in the auto mode made to simulate lunar gravity. Attitude of the vehicle and translation control will be accomplished with a standard stick and rudder pedal fly-by-wire system.

#### Side-Arm Controllers

Stick will be used to control pitch and roll (about the longitudinal axis) and rudder pedals will control yaw. Both fingertip and conventional grip side-arm controllers, which eliminate rudder pedals, will be evaluated during the flight program. Side-arm controllers, such as those used on the X-15 research vehicle, will provide control about all three axes by compensating yaw control as a rotation of the control handle.

Conventional grip controller has a

shaped handle, gripped by the whole hand, while the fingertip controller has only a small knob on the end of a pencil-thin stick and is gripped by thumb and fingers.

Pressure enclosure will surround the pilot, providing good forward and side visibility. Visibility requirements for lunar landing will be investigated during flight tests. These requirements will be determined by making self-portraits of the enclosure with optical plethysmographs (a thickness to collimate) and providing the pilot with a clear view, which effectively minimizes visibility through the window area. Technique is similar to that employed on conventional aircraft instrument housing and has a safety feature of providing unobstructed visibility when pilot's view is removed.

#### System Backup

During the descent from the lunar position, the pilot will rely on the FETV with the collective, which contains two 600-hp thrust hydrogen peroxide rockets. As a backup, in the event of jet engine flammout, four additional lift rockets are available, providing up to 3,000 lb. total thrust from the lift



#### Device to Test Astronaut Cockpit Tasks

Ease with which a space pilot can perform typical cockpit tasks while fully suited will be tested by a device built for the National Aeronautics and Space Administration's Manned Spacecraft Center, Houston, Tex., by the Applied Psychological Services Co., Wayne, Pa. Rig includes a modified couch for pilot-subjects equipped instrument panel, plexiglass eye test apparatus console. Speed and accuracy of a subject's ability to activate interlocks and push button switches will be determined by the time lag between a stimulus, signaled by a light, and his response in moving the switch to turn off the light. Pilot also will make a minimum control check, in a test of his coordination, to sign and then hold checklists on a screen on the instrument panel. Subject's space suit will be instrumented to measure the extent of his wrist, elbow, shoulder and knee joint movements. Fingertip will be suspended from an arm over the couch to determine how far a pilot can lean his head to read the scale. Yaw also will measure extent of a subject's reach. Six channel plexiglass will monitor and record body temperature, galvanic skin response, respiration rate, blood pressure and heart rate during test exercises. Device is expected to provide NASA engineers with criteria for the design of space capsule controls to assist in evaluating space suit design.

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rocks. The thrust level matches the vehicle's weight with a full load of fuel. Empty weight is 2,600 lb.

Two 300-lb-capacity hydrogen peroxide tanks will furnish sufficient fuel to operate all six tilt rockets between zero for two minutes. The hydrogen peroxide system is pressurized by two 6,000-psi helium tanks.

Forward or lateral movement is accomplished by tilting the servomotors forward to achieve the desired velocity movement and then righting the vehicle and coasting until it is decided to stop the translation. This is done by tilting the servomotors in the opposite direction, through the same angle and for the same amount of time, in order to remove the original velocity component.

Variable pitch/tilt and control system achieves 100 ft/sec thrust hydrogen peroxide

rockets, mounted in opposing pairs, to control attitude. Eight can rockets are mounted in pairs in a horizontal plane around the perimeter of the framework at the center of gravity level.

Only two rockets are used at any time for yaw control (roll about the vertical axis). The two rockets are located on opposite sides of the PFTV and provide thrust in opposing directions to provide rotational torque. Only four rockets are necessary for full yaw control, and extra rockets will be different fuel tanks, provide complete redundancy in case of malfunction or fuel starvation in the main system.

Extra yaw rockets also provide yawer translation capability, the ability to move forward or laterally without tilting the vehicle. This technique also will be evaluated during the flight test program.

Eight pitch and roll rockets, mounted in pairs on the lower portion of the legs, provide complete redundancy, since control in these two modes can be accomplished by utilizing only four rockets.

Zero-zero Weber Aircraft Co. pilot seat will be installed on the PFTV. The light weight, rocket-seated seat has a footprint of approximately 200 sq. in. with forward separation of the seat from the pilot and airframe about 40 in.

Landing shock will be absorbed by other parameters in the shock absorber. Final design has not been final. The shock absorber will have flexible joints designed to absorb vehicle shocks at velocities up to 3 fps.

Close to them is designed to withstand vertical decelerations up to 10 g's. In one the simulator contacts the ground with

## Lunar Approach Techniques and Landing Problems Defined

Los Angeles—Lunar approach techniques and landing problems currently under study in the Apollo program were defined here recently by Joseph S. Algranti of National Aeronautics and Space Administration's Manned Spacecraft Center. Algranti, chief of the center's Astronaut Operations Group, presented his report at the American Institute of Mechanical Engineers' Aviation and Space Conference.

Landing approach to the lunar surface will begin after the command module has been placed in circular orbit around the moon at an altitude of 60 nautical miles and a velocity of 1,536 ft/sec, Algranti said. After separation from the moon vehicle, a small change in the velocity vector of the LEM is introduced by firing toward the center of the moon, putting the landing vehicle in an elliptical orbit, apogee about 100 nautical miles and perigee about 10,000 ft.

Coasting period of 10-30 min., during which the landing vehicle increases about 90 deg. of lunar longitude, brings the LEM to its nearest approach to the moon, where final landing begins. During descent there is considerable rotation of the vehicle about the descent axis and the vehicle pitches up to a vertical attitude and levels at 1,000 to 3,000 ft. altitude.

Pilot then chooses a suitable landing site and begins the final portion of the descent to a soft landing. Precise attitude control requires that the pilot be able to translate 1,000 ft. from being hovering and touch down while two engines after the pitch maneuver.

During the final portion of the moon landing, use of lift forces for attitude control by gimbaling the lift engine or the vehicle translation by tilting will result in slower acceleration from an earth. The slower acceleration results from the lower power level (between 1 to 200 ft/sec) available to move the main mass. To compensate for these slower handling characteristics, it will be necessary to increase pitch and roll lift angles to 30 deg. The 30-deg. lift angle will provide about the same response in a 5-deg. roll angle with a full-power situation as usual.

Altitude total clearance of lunar atmosphere—16" that of earth—will result in the landing vehicle not being subjected to aerodynamic drag or drag forces. This absence of drag and damping will affect handling qualities of the vehicle. Algranti said, since no speed stability or resistance to velocity is provided.

Manual landing approach is more likely to succeed than any

fully automatic system, Algranti said. Pilots have already demonstrated ability to control pitch (attitude) without velocity control, without stabilization and damping, given proper handling qualities, he added. Also, the only complete automatic landing system approaching operational readiness—the British RL10 system (AVR-100) is a 700-psi-pressure hydrogen gas-fed ILS equipment, which won't be available on the moon.

Little work has been done to date on the final landing problem in analog simulation studies, Algranti noted, because it is difficult to program rate comparison. This problem will be closely scrutinized in the dynamic simulation research program.

Simulation studies to date have established pilot performance for a rate measured system with an attitude hold. A backup system with acceleration as an acceleration demand system. However, this approach requires much more training for good pilot performance.

Characteristic velocities observed in analog studies are descent rates of 2 to 6 ft/sec and translational velocities less than 1 ft/sec have been obtained at touchdown, Algranti said.

One common problem evident from analog simulation studies at lunar approach is "bounce" seen from the moon during the pitch-up maneuver. "Bounce" is due to unbalanced introduction of a shaft component, resulting from residual thrust of the landing engine which causes the thrust vector to deviate from a horizontal thrust.

With the speed decrease in lift weight—about 90% during the landing maneuver—and the low base gravity, pilots have often found themselves climbing away from the simulated moon surface with velocities that can be met a small percentage of landing fuel left, Algranti said.

To overcome this problem it will be necessary to furnish ILS pilots with some type of guidance for a controlled pitch maneuver to avoid "bounce" in the power engine that down and right capabilities during the moon phase.

Guidance system for the controlled pitch maneuver probably would be in the form of an instrument display for the pilot to see the maneuver, rather than a completely automatic control.

One form of presentation might be the horizontal and vertical bars on an attitude scope (similar to ILS attitude). Engine shutdown and slight capability during lunar approaches a reliability factor and probably will not be incorporated under other methods given reported.

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FFTV will test an in-center wheel for run ground handling during initial flights. These will be achieved with pods later in the test program. Maximum speeds of the insulator probably will be about 70 mph horizontally and 60 ft. vertically.

Calculation of drag on the unsteady motion stage of the PITV, however, has proven difficult, and verification of the performance figures in the wind tunnel will be arduous. Coding, with the present jet engine, will be about 1,000 ft/sec sea level on a warm day.

## System Detects Holes Caused by Meteoroids

Technique for detection and location of subsurface holes in overhead space system has been developed by the Magma Co.'s Denver Div.

Station takes advantage of the double-hull construction on outer water-tight bulkhead and an inner pressure bulkhead—that will be incorporated in future spacecraft and space stations.

The boys—which would be permitted

before installation to allow expanding gases to bleed off as the vehicle loses the earth's atmosphere—would contain pressure transducers connected to a suitable alarm system.

In the event that a meteoroid should penetrate the bumper and be stopped by the insulation in the vent bag, an alarm would be issued, since there is no pressure external to the spacecraft which would stimulate the pressure transducer.

But if a suspect penetrated the inner hull of the vehicle, life-support air would leak into the vinyl bag and activate the alarm system. The crew would immediately be made aware of the danger and if the pressure transducer leads from each bag were connected to separate lights on a hull status panel they would know the approximate location of the hole.

The inside wall of the cube could be patched quickly and easily, and the effectiveness of the repairs would be measured by the alarm system, which would remain activated as long as air continued to seep.

Martin built and tested a working model of the system late last year. The insulation-filled vent bag functioned properly.

Even though the bag was punctured numerous times, the pressure transducer actuated the alarm whenever air was introduced into the bag.



### Ocean Tracking Station Proposed

Gateway during shows representative configuration of stable scene platform proposed as spaceport tracking system station by General Dynamics/Avco/Boeing. Station is towed to horizontal position in launch; then tilted upright by flexing hull compartments. Tracking equipment is located on top deck; dining and recreation areas on second and living quarters on third. Bottom deck is for storage and maintenance.

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## PRODUCTION BRIEFING

Fast-Low Jet production components are being assembled in wing, fuselage and empennage shops at the company's Wichita Kan. plant. Initial customer jet aircraft is scheduled to fly in June and the second and third B-1 Supersonic Ground-stand tests of the GEI 610 powerplant are expected to be completed at the company's Wichita facility later this month.

Bristol Siddeley Engines, Ltd., and Alfa Romeo S.p.A. have signed an agreement covering manufacture and overhaul of General Helicopters engines in Italy. Gamma, based on the General Electric T55, is the powerplant for the Agusta Bell 204B helicopter.

De Havilland Trident transport completed high-speed landing and takeoff earlier this month, reaching a top speed of Mach 4 in level flight and Mach 58 in a shallow dive.

General Atomics Ltd., Solana Beach, Calif., will conduct a second phase of research on auxiliary nuclear power space systems under \$150,000 contracts awarded by the Atomic Energy Commission.

### Space Parachute

Systems and weight tradeoffs between a payload-to-orbit combination and an unguided payload configuration for earth and planetary (Venus) atmospheric entry will be examined in a new month's study for NASA's Ames Research Center—now circulating competing proposals submitted late last month.

Grady will examine a possible system with subcontractors to provide some translation capability and maximum cost bid to market.

It will attempt to establish an optimum configuration with the least two persons between a lower and transition type landing and a non-attainable vertical parachute landing (as in the Moscow, example).

Degree of horizontal anisotropy will be one of the parameters, to determine if a streambed permeable is required to consider wind drift or if lateral translation can be handled as the terminal anisotropy alone.

Various arrangements will be authorized for locations of rocket motors, thrust chambers and propellant tanks. For example, the use of several casted motors fastened to the vehicle nose, the closed loop, is important with either a single nozzle type thrust chamber or with multiple chamber, will be examined in the study.



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ELECTRONIC SYSTEMS DESIGN



## CAPABILITY BEATS SPECS

This 11' dia. x 28' space environment chamber built by PDM for Los Angeles Division of North American Aviation, Inc., was designed to produce a vacuum of 5 x 10<sup>-7</sup> Torr in four and one-half hours. In shakedown tests it reached this level in two hours and ten minutes. It went on to reach 6 x 10<sup>-7</sup> Torr without an LN<sub>2</sub> shroud or tankage. In addition to present performance excellence, provisions have been made for an LN<sub>2</sub> shroud and bakeout. Consult PDM on your space facility requirements.

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## AERONAUTICAL ENGINEERING



**LATEST VERSION** of Czech-designed and developed L-29 biplane jet trainer is shown in new picture above. Design changes put earlier model outside limitations of speed brakes on sides of new fuselage plus provision for auxiliary fuel tanks beneath the wings. Aircraft apparently also can accept a new radar installation. A second L-29 is parked in the background (upper left).

## Czechs Seeking Foreign Outlets for L-29

Genera-Czechoslovakia is seeking foreign market outlets for its recently developed L-29 two-place jet trainer specifically designed to operate from the road and narrow runways still prevalent in a number of areas including large sections of East Europe, Africa and Asia.

First formal report from Czechoslovakia came the lightweight aircraft is powered by a domestically designed M781 turbojet engine with 190 lb thrust. Engine assembly was developed by the Walter Motor group of Czechoslovak Aviation Department.

Designed for use through basic and advanced training cycles the L-29 has at least a marginal all-weather capability and can be converted to a combat configuration if required. The Czechs report state that the jet-wing aircraft can be adapted to both intercept and close-range modes, carrying either air-to-air or air-to-ground missile systems.

The L-29, 65 ft jet aircraft known to have been completely designed, developed and built in Czechoslovakia for mass production, has a quoted maximum speed of level flight of 353 mph at sea level. Maximum speed at an altitude of 16,400 ft is quoted as 407 mph.

Maximum rate of climb is claimed to be when equipped with either thrust vectoring or in category-2,700 ft/sec at maximum takeoff power at sea level 2,160 ft/sec at maximum maximum power at sea level. Maximum endurance using only the 254 U.S. gal ca-

pacity of the internal fuel system is 2.5 hours at 165 mph. Installation of two performance auxiliary wing tanks with a total capacity of approximately 50 U.S. gal. boosts this figure to 150 min., according to the Czech reports.

Fuel consumption is quoted at between 112 and 118 U.S. gal. depending upon speed and particular weather conditions. Maximum range with a 195 fuel nozzle is said to be 400 mi. with out wing tanks, 555 mi. with them.

Aerial photographs of the aircraft in design that the present version of the L-29 has been modified from an earlier model to incorporate a number of design changes. These include:

• Revision of non-extended landing

light shown on earlier model to an alternative location on the forward landing gear nacelle. New section on latest version also appears to have provision for installation of a radar antenna.

• Provision on the newer design, which can be operational configuration, for installation of a pilot-mounted instrumented fuel tank beneath each wing.

• Shift in location of the pilot's fuel tank. Earlier model carried a pilot tank on the left wing tip with a sensor positioned at the base of the horizontal stabilizer of the T-tail design. In the latest version a pilot tank is mounted closer toward along the leading edge of each wing section.

• Installation of speed brakes on either side of the rear fuselage section.

• Effort apparently has been added to wing root area showing cut or intake, and the exhaust wing section appears to have been strengthened and modified.

Czechoslovakia officials on the aircraft, in each five-year life made more than 1,500 test flights for a total of about 1,190 hr. in the air in part of its preproduction certification program. A Czech report on the L-29 says:

"As a result of these tests, it was chosen from among several prototypes of biplane training airplanes as occupying best with the requirements imposed on airplanes of this category."

"It can therefore be expected that the L-29 will be used also in foreign air forces."

### L-29 Specifications

|                             |              |
|-----------------------------|--------------|
| Wing span.....              | 33.75 ft.    |
| Wing area.....              | 295 sq. ft.  |
| Wing aspect ratio.....      | 9.54         |
| Length.....                 | 37.47 ft.    |
| Height (to ground).....     | 18.27 ft.    |
| Empty weight.....           | 4,545 lb.    |
| Normal gross weight.....    | 7,240 lb.    |
| Max. gross weight.....      | 7,930 lb.    |
| Max. speed (sea level)..... | 353 mph      |
| 1st 30,000 ft.....          | 407 mph      |
| Range, standard fuel.....   | 400 mi.      |
| Range, with aux. fuel.....  | 515 mi.      |
| Max. rate of climb.....     | 2,760 ft/sec |
| Max. ceiling.....           | 17,500 ft.   |
| Service ceiling.....        | 15,000 ft.   |

# Pershing, Launcher System Field-Tested

First firing of a Marlin Pershing ballistic missile in a series of "rough-haul" transport tests at Camp Crockett was carried out only this month by Marlin-Olinda Co. personnel with troops of the 4th Artillery Battalion, Ft. Sill, Okla., as observers.

Firing took place Apr. 5, two days after the last R&D shot. Later flights are being carried out with Atlas personnel replacing Marlin personnel in increasing numbers.

Troops from the Ft. Sill unit conducted their first test firing on 12 Jan. In that shot, the missile, fired from its launcher on a doped single surface, as expected in the pre-selected target area.

First exercise involved movement of the assembled missile on its mobile launcher together with a complete set of tactical equipment through rough terrain near the Marlin-Olinda plant. The missile and equipment were then returned to the plant, disassembled, repacked in containers and moved to the Corps for firing. No attempt was made to duplicate a tactical firing.

Purpose of the exercise is to gain field firing experience with the Pershing and its launcher in the limits of troops from a regular Army unit.

The launcher, officially known as Erector - Launcher-Guided Missile Transportable (ELG-MT), is manufactured by Underwood, a division of the Union Match Corp. of St. Louis, Mo.

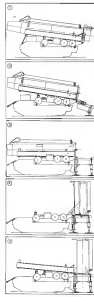
Launcher is used differently in three modes of Pershing delivery:

- **By truck.** Missile sections are transported into the area by truck and the mobile launcher is hauled by truck back on the XM-474-2 trucked vehicle. At the launch site, a crane truck, one of two trucks included in the system, hoists the missile sections onto the launcher for checkout, erection and firing.
- **By mobile launcher.** Missile sections are hoisted as loaded on the launcher atop the XM-474-2 trucked vehicle and moved to the launch site as a complete unit. Worksheet is assembled at the site and the missile is checked out, erected and fired.
- **By helicopter.** Missile and support equipment is transported to the site by helicopter (AH-1F) Feb. 4, a B-1. A light crane truck, also flown in, raises the launcher into firing position where the missile sections are placed on it for firing.

In a typical launch situation, the missile has guidance package, warhead, fins and umbilical cable acts in the launcher's control frame with its cone slightly elevated. The armrest ring which is hinged at the base of the

launcher, is connected to the base of the missile motor.

Launcher jacks, also hinged at the base of the launcher, are swung down and its three jacks positioned. The third, or outermost, jack is manually operated. The center frame then lowers the



**UNIDYNAMIC's** mobile launcher shows step XM-474-2 trucked vehicle. When launch sequence drawings show target launch pad swing down and positioned by jacks. Worksheet, guidance package and fins are skidded in step 5.

similar to the horizontal where the two-down are received. First, guidance package, warhead and umbilical cable are attached at this stage.

Next, manual lowering of the entire launcher is performed. Leveling is controlled automatically and initiated when a rotary switch on the control panel is turned to the "Sublevel" position. Some operators also swing the fire control jack to begin horizontal checkout.

When leveling and horizontal checkout are complete, a light signal indicates the missile is ready to be aimed. The rotary switch is turned to the erect position and missile is aimed toward the vertical.

If the launcher begins to tilt as designed or more, a alarm sounds and the correct is stopped while automatic re-leveling takes place. When the launcher is level again, the alarm stops and motion continues.

When the missile is in the vertical position, starting on its launch ring and launch pad, the erector is disassembled and lowered. While the erector is lowering, fire leveling of the missile takes place. When this is finished, the missile is rechecked to the correct aim with the armrest drive motor. The armrest ring clamp is then removed and the missile is ready for firing. The complete firing procedure is expected to take only a few minutes.

Main variation of this basic procedure occurs when the missile sections are loaded at the launch site. Here the armrest ring and launch pad are swung out of the way while the loading takes place. The first stage is lowered from its container by crane and lowered onto the erector frame, with the least supported by pedestal mounts.

Launcher pad is swung up to position the armrest ring against the base of the first stage. After this, the launch pad is lowered and its jacks are positioned against the ground, as described before.

Second stage is removed from its container and mated to the first stage with the aid of a crane. After the stage is mated, the crane is used to raise the missile slightly while the pedestal mounts are removed. The missile is then lowered into the erector frame and the remainder of sequence is as described above.

Mobile launcher mechanism is electromechanical except for the one manually operated jack on the launch pad. The erector is designed so all electromechanical operations, including leveling the missile, can be performed manually in the event of a power loss.

Mobile launcher weighs 5,500 lb., is 20 ft. 3 in. long, 6 ft. 11 in. wide and 8 ft. high.

## MISSILE ENGINEERING



## Army Cold-Tests Pershing Missile

Army-Marlin Co. Pershing solid-propellant field ballistic missile system recently completed more than three months of cold-weather environmental tests at Ft. White, Alaska. Tests of propellers and a dummy into one were not, but the missile and ground support equipment were of tactical field configuration. Army and Marine unit tests were conducted successfully in temperatures from -45 to -60 F. Systems will be overhauled in Marlin's Okla. plant prior to deployment in the Pacific Command Zone for tropical tests. Shrouded missile on its mobile launcher (above) is lowered to the programmed test station. Firing is carried by a vertical launch system (right) by the erector-launcher. Elevated nose (below) shows (1) communication with two independent radio links for forward sight and topographic center communication, (2) the nose, (3) the missile, (4) the erector-launcher and (5) the programmed test station and procedure.



## Teller Urges Strong Nuclear Management

Dr. Edward Teller, a Los Alamos physicist who developed the nuclear thermonuclear weapons, believes that the U.S. has lost ground disastrously during the last 10 years. Aviation Week & Space Technology is reprinting an essay which appears in the book "Science, Technology, and Management," edited by Kurt and Rosamund with the permission of the publisher—McGraw-Hill Book Co. The book is a compilation of papers given at the National Advanced Technology Conference September 1962 at Stanford. Teller traces the losses of nuclear wealth from the day of the Manhattan Engineering District to the present, outlining management problems, their solutions—Ed T.

I have looked at management from all angles myself from above—initially but I can look at it from below. For a long time I have viewed management from below and this gives me the perspective to discuss the management problems of the hydrogen bomb program with you. I will present my experiences with the nuclear program—the early Manhattan Project, the development of thermonuclear weapons, the establishment of the new laboratory at Livermore, and the present situation regarding atomic energy.

At the end of World War II the U.S. was the most powerful nation on earth. We had the atomic bomb, we were the masters of nature, we led in science and technology, and were the most advanced nation in the world. Today, 17 years later, the U.S. is still the wealthiest with a high standard of living. On the other counts we have not fared so well. While we use the war with our overwhelming superiority we have failed to focus all of our resources—national and human—toward winning the peace.

The work of the Manhattan District was a phenomenal success. We had fast diffusion to produce fissile materials. Actually, the manufacturing of fissile materials is the first of the problems of producing atomic weapons. When a nation produces fissile materials it is only a few months until it has a bomb. Let it not lead ourselves into believing that keeping the secret of the atomic bomb or even producing any tests will stop progress and stop the spreading of nuclear laws. The major difficulty is the past regarding our financial and industrial economy to make fissile materials. We should not encourage the Manhattan Engineering District for being worried in approving the first peaceful programs for the production of fissile materials. Although not all of these tests cost the few millions of atomic weapons, they have been reduced in many other technologies. Ernest Lawrence's method of separation of isotopes with the electromagnetic process has given

us a wealth of isotopes which are useful in science. The Manhattan Project was a great success, not only because it produced the atomic bomb but also in the by-products which it yielded. Many enterprises which have failed and have usually wasted an enormous endeavor have yielded by-products which more than justified the effort. We cannot do science before and never too sharply—scientific advancements usually come across a broad front with small refinements building up to the total as completed.

The atomic bomb project was a success because of the enthusiasm and hard work of all participants. The scientists knew what they were working for and they had their hearts in it. The technicians as well as the scientists had an objective. This project brought new insights and problems for us to solve. It was not fear and protest contact with the kind of reality where rules, discipline, and consensus or cooperation could lead to some gains we've never—results that could change the face of the world. It also required difficult adjustments for the scientist. The idea to work by himself or with a few others naturally and at his own pace. It was a great shock to find our ideas taken and given to others to develop, much as your children being taken away where they are two years of age.



Dr. Edward Teller was born in Budapest, Hungary, and came to the United States in 1935. He served as a physicist at physics at several U.S. universities until 1942 when he helped develop the atomic bomb with the Manhattan Engineering District. He later continued his thermonuclear research with the Los Alamos Scientific Laboratory. He has been professor of physics at the University of California since 1955, and is presently known for his role in development of thermonuclear weapons. Dr. Teller is director of the University of California's Radiation Laboratory, Livermore, Calif.

Science and computerization provided additional problems for the scientists. Even though during a war an unusual emergency they are here their place there are many changes involved in their applications. Let me discuss the problems by one of my experiences. On the atomic project one of our functions was to provide screens against accelerated nuclear explosions. In the diffusion process for manufacturing fissile materials there are some changes of a nuclear explosion. There is a procedure where the engineers who maintained the facilities were not allowed information about the conditions which might bring about an accidental nuclear explosion. Yet it was my function to assure that such an explosion did not occur. The other safety and computerization of information created great difficulties in communication and it was not because of the good will of the various people—scientists and engineers—the engineers were disappointed.

When the Manhattan Engineering District had accomplished its objective, the majority of the good scientists went back to their regular work. This was natural for much of the basic scientific research had been retained during the war. Nevertheless, the studies of top scientists placed the rate atomic energy program in jeopardy. A few people, under the leadership of Norman Feshbach, carried on at Los Alamos. At that time I proposed that we should do one of two things, (1) we should pursue fusion experiment vigorously with a program of \$250 million per year, or (2) should concentrate on the next phase, fusion and the hydrogen bomb.

The actual results are clear and complete; neither of these things were done. Few technical people were available and the political temper of the country, and, even more so, of the scientific, was opposed to the program. Now comes the \$64,000,000 question (and even this is an understatement). Why was there so much opposition to my proposal? Part of the answer was the failure to recognize a sufficient number of the scientific community of the world for continued development. After giving something as tremendous as the atomic bomb they considered it nothing—nothing bigger could exist, or if it could, it would wait matter. Part of the answer was the deep and painful desire for peace. Another factor was the handling of tomorrow as a present problem. While the scientists realized themselves in this generation as doing the war, they could not believe it after war. Part of it was that I could not really understand why the political feeling of guilt—fear and guilt that the atomic war could be the end of the world.

I actually agree that in all-out atomic

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about forward looking in their decision making then we were during this time period.

This was a case of severe repression of our national security program. For us to continue to mark time was, in my mind, very dangerous. It was apparent that we should move for the hydrogen bomb. However, there was still substantial disagreement as to whether or not to pursue the program. The General Advisory Committee, the staff of the Atomic Energy Commission, turned the program down. They did not say that it could not be done as cooling in the decay. However, they did develop a number of other repressive objectives. If it could be made, it could not be discussed once the target became of

the beds of large enough airplanes. We had enough nuclear power, no more was needed, so why have massive capacity to hit the enemy? It would be much too expensive and would be wasteful. Above all, it was another point in the designers was said. Let us not pursue the program, that the Russians will not proceed either.

With the recommendation for the rejection of the program then, was a feeling of utter despair on the part of people at Los Alamos. While they were making an intense invasion they had support. But the moment that we proposed a more scientific program making significant breakthroughs it was called irrational. None of the people actually involved in the work would accept

this. The decision regarding whether this program would be implemented was a most crucial management responsibility.

Finally President Truman made a decision. I know that many men opposed the decision but when men frightened men were saying strongly that we go ahead. The decision was made in contrast with the development of the hydrogen bomb.

#### Aiken Bomb Technology

But the decision also brought constraints. Consider when? We only had a few thousand an paper and a few general parameters. We had directed it a great deal. I had been thinking about it for years but we were not to be advanced in technology as we were in 1950 with respect to the atomic bomb.

One real problem, a very difficult one, was in getting qualified personnel to work on the program. But we did obtain them—a few brilliant like John Wheeler, a number of young talented people, and recruits from outside Los Alamos who had already decided that participation was something we could not neglect. There were some major losses which caused. Management to do a great deal with intelligent and relatively inexperienced people who are highly motivated.

Patterns for the working of the program developed. It was one that we did not need the hydrogen bomb, and that it really would not pay. Also there was strong pressure to ensure that the first device could have practical applications. We reacted all at these pressures.

We insisted that as a first step we should not attempt to make a bomb at all. We set forth in design something that was new, not something which could be used, but an experimental device that would prove the theory on the resident people, scientists. After proving the theory we could then go on to make the bomb. I was both confident that once the principle was established we could meet the requirements for making an operational bomb.

#### Understanding Advanced

We built a laboratory in the Pacific and then New York, and we had before the attack pointed in the explosion were recorded and the experiment completed. However, we had to make major alterations in our plans. As we advanced our understanding, we found that the original approach would not be successful. The new theory was when you are putting the output of a nuclear reactor into the experiment, you are not in a vacuum and we are able to develop a correct theoretical approach and not understand a work which. Findings which could not be considered.

After the successful completion of the experiment I decided that we no longer needed to see Alamos. I understood the role of getting out of the laboratory and into the field—and of establishing a new laboratory.

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BS or MS in engineering, physics or math with two or three years of experience and familiarity with the application of analog and digital computer techniques for space use in the following areas:

**STABILITY AND CONTROL:** to conduct theoretical studies on the control dynamics of lunar space stations and space vehicles. To determine stability and transient response of space structures in the presence of population shattering, thermal breaking modes, and non-linear and non-stochastic forces. Must be familiar with analysis and synthesis techniques for model building and evaluation of control system parameters. Background in structural dynamics is required in simulation control system environments and general dynamic behavior of space habitats.

**STRUCTURAL DYNAMICS:** to determine response of an elastic space structure to various loading such as atmospheric turbulence, engine vibration, vehicle support. Operations also cover in establishing structural response, more based upon use in structural design for evaluation of components and systems, and for assessing risk of complete or partial destruction of space vehicles, including impact of mass gain, such as structural requirements, loading factors, etc.

## ADVANCED ELECTRONIC SYSTEMS

Engineers are on tasks projects as lunar habitats, advanced tracking systems and payload products. Experience should include advanced design work in microelectronics, as guidance, communications, telemetry, data processing systems, mission systems, or other prime payload support systems. An advanced degree is desirable.

## STRESS ANALYSIS

Specimens are required to perform stress analysis on advanced attitude and space vehicle designs and standard ground equipment. The development of new analysis methods and use designs for evaluation of structural adequacy are additional roles in this area. BS or MS degrees and at least three years of experience experience are prerequisites for these positions.

## ELECTRICAL ENGINEERING

BS or MSET with applicable experience required for assignments in locally mounted systems design, packaging, test equipment, remote electron power systems or computer and systems management. Operations are in design, development, vehicle qualification, selection, and test and ground and offshore remote electron equipment.

Openings also exist for graduate engineers in the following: STRUCTURAL DESIGN, RELIABILITY, ELECTRONIC DESIGN AND DEVELOPMENT, OPERATIONS AND SYSTEM ANALYSIS, WELDING ENGINEERING, MECHANICAL DESIGN, STANDARDS AND CALIBRATION LABORATORIES, and TECHNICAL WRITING.

## THERMODYNAMICS ENGINEERING

BS or MS in ME or AE to develop design concepts and perform methods development in the area of thermodynamics. Personal considerations are research interests, low-temperature, high speed, and condensed matter systems. Should have two years of experience.

## INITIAL GUIDANCE

BS degree in physics, EE or ME and 2 to 3 years of experience in one or more of the following:

**OPTIMUM DESIGN:** capable includes establishment of guidance and flight control system optimization, analysis of system performance, establishment of test parameters and evaluation of design changes.

**AUTOMATED DESIGN:** skills in the design details and development of the Control system vehicle flight control system. The system includes the integration, programming, design, and plan in tracking equipment. The designer is also responsible for design of recovery test equipment.

**OPTIMUM ESTIMATION:** requires and includes with design and fabrication experience for autonomous control and to monitor the different guidance system is necessary and available. To achieve the goal, the designer must have proven analytical skills to conduct system control.

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**CORPORATE:** Reliability Hardware Design, Hardware Analysis, Hardware, Component Reliability, Parts and Materials Selection, Reliability Concepts, Support Processes and Evaluation.

Operations may be experienced engineers with applied higher education education preferably in electrical BS degree required, higher degree preferred. Career studies with customer and design experience is also desirable.

## AERODYNAMICS

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ment in the technological world. One person in particular, public relations in government work, or the future center part of a theme if this does not succeed? The staff member and administrator in the business community for scientific growth. Public relations must be an important role in a security. This there is nothing left but companies. I felt that a second laboratory was needed to provide a second chance in case of failure of the present project and to provide needed competition to Los Alamos. People made the request of departments and units. We had the need duplicated when talking about government facilities and programs, almost as if to indicate we had about competition. I do not know which is the most appropriate to see but it seems that a little legislation is better than no competition. For example, that is how Washington was a

## Effective Management

One read about an expression of effective management that of the Atomic Energy Commission. It was told to be clear about the program and was given a clear plan to do something new which required more management in science and technology. We had and we had. Then we had more and we had again. At the time we could reasonable management could have that as done but the NEC management was

not reasonable the management was good. They recognized that something new can be accomplished without taking risk and so we were encouraged to experiment for the. The next time we succeeded.

## Numerous Problems

In 1944 Herbert Gold left the Johns Hopkins and I took an overall responsibility for problems were more. Public opinion was general concern. Experience. The government policy was against atomic exploration at least in this field. We had one major situation—a group of people who were dedicated to their work. We had advanced from Ernest Lawrence a decision-making process almost everyone would participate in the discussion and analysis before a decision was made.

I proposed an executive decision group which, with division, could be responsible for the use of the 400-man laboratory but also participated in the overall decision making.

One major decision which required work management report was to continue the major portion of our research work in preparation for further tests. This case is quite an unusual policy of a military institution. We prepared to let our mind with the maximum placed upon it. It was not enough because our doors open not by experiments and learning can be



## MSC Mission Control Center Layout Shown

Model of several floor of 580-sq-ft Mission Control Center is to be built at NASA's Marshall Spaceflight Center for controlling Gemini, Apollo and future space flights during upcoming flights. All flights will be controlled from the center room, reported by Flight Dynamics, Ltd. Support Vehicle Systems Network Support and Operations and Functions staff rooms to the left of the center room. Classroom rooms to the right of the main control room. First floor of MSCC will house the computer complex, operational and communications facilities for telemetry, ground station and landing radio operations, communications equipment, and associated TV. Duplicate room control and staff support rooms will be located in the third floor of the MSCC.

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really successful and the test has took this valuable element away from us.

The problems of maintaining enthusiasm and morale at Los Alamos and Lawrence were somewhat greater than during the Manhattan Project. In wartime there was a very deep, dedicated interest in preventing the problem of stimulating interest among the people at the laboratories became extremely important. We attempted to create flexibility so that a person could participate in deciding what work he was to do. If he was told on the track then we had little problem maintaining enthusiasm.

### Morale Bolstered

Another approach that helped greatly was to take the people into our confidence. We told them where things stood, and also the broader view of what was going on. Some times when my thousands of people at Lawrence were actually working on plans which might never be executed. This was a severe stress and not conducive to the best work. We kept the pressure of the need to operational data on the work to month projects in the laboratory and have it not related to the operations going on outside. In those times we managed to make it clear to scientists at the laboratory how their initiatives and work was unique at the whole context of national security. It is amazing how much effort it took to build and how few more people who really believe in the program transferred this conviction to the work and life.

Creating and maintaining spirit and enthusiasm was the most important management job at the laboratories.

Management of our nuclear energy program and many other problems of perception of need and decision making. Today, again we have enough and that further development is not necessary. This means that everything that is worth knowing about nuclear explosion is already known. There are the same basic questions need against further research and development efforts which have been used for the past twenty years. The possible peaceful use of atomic energy in building houses, roads, and in mining are ignored. Today is the the original discovery of the hydrogen bomb, we were to be ahead of our elements and we were silent on having the clock back.

### Prime Function

Management's prime function is to make decisions. In the scientific and technical field this is an opinion that the right decision is made to go ahead with this or that, and decisions on technical grounds. After the decision is made, the right scientific personnel to carry the program out and give them freedom and freedom in pursuit of the objective. It is that simple, not a very simple. It is of vital importance for us to go on with our clear program. We have lost ground due generally in the last 17 years. We cannot afford to continue in this position of indecision indefinitely.

# More Defense, Space R&D Fallout Sought

By Katherine Johnson

Washington—Kennedy Administration, confident of this nation's dominant position in the space race, soon will launch a pilot program to stimulate science and technology for U.S. civilian industries.

As a starter, the House recently approved \$750,000 for financing during May and June the last two months of fiscal 1963. The President has asked \$1.4 million for fiscal 1964.

One of the main objectives of the program is to obtain "front-end" studies—basic studies and spin-off research and development that can be applied to civilian industries.

There is a wide divergence of expert opinion on the effort.

Dr. Jerome H. Wiesner, director of the White House's Office of Science and Technology, believes that in defense technology advances, it has less and less relevance to the civilian economy—both directly, except for such as communications satellites. He has warned Congress in a report there is a shift in emphasis from defense and space to civilian technology. The U.S. faces "a very serious, imminent problem" (AW Aug. 5, p. 18).

Dr. Edward C. Welch, executive secretary of the National Aeronautics and Space Council, takes the opposite view.

He holds that one of the best justification for space programs is the by-products that will occur to the civilian economy. (AW Oct. 28, 1962, p. 38).

Dr. J. Herbert Holloman, who as assistant secretary of commerce for science and technology, will administer the new program, claims the answer is largely unknown since there has been little effort so far to translate the findings of military and space research into civilian activities.

There are two projects planned by his office.

• **Application of computer technology.** New models need to be developed to make more efficient civilian industries.

• **Screening of space and defense in fusion and development, with an eye specifically on their industrial applicability.**

The program will be supplemented largely by government grants and contracts to universities and non-profit organizations.

The Los Angeles is the Administration's first to stimulate civilian technology. Dr. DeWitt C. Macomber, Secretary, Defense Research and Development Administration, of the Council of Economic Advisors.

Two days last past month established an advisory panel on civilian technology, headed by Dr. Milton Eisenhower, president of Collette Co. The panel recommended the pilot program

was getting under way as a first step to start the sluggish economy and retain a dominant U.S. position in world economies.

On Holloman's recommendations, the past of research activities for science and technology was also authorized by Congress last year. Before assuming his position, Dr. Holloman was general manager of General Electric Co.'s general engineering laboratories. He also has experience over Western Electric, the area of Standards, Coast and Geodetic Service, Patent Office, and Office of Technical Services.

Dr. Holloman recently told the House appropriations committee:

"It is well known that the nation's defense posture and our space program depend upon research and development. It is less well known that our economic growth and our ability to compete in world markets are almost entirely determined by science and technology."

In recent years, he noted, to deal with the Russians, it is urgent that in the space race has created a preoccupied shift in concentration of research and development from civilian to military and space programs. This shift has affected even our universities and technical schools, where research and development are increasingly concentrated in fields that support the huge space and defense effort.

Formerly, military research often



## Kaman K-1125 Begins Flight Tests With PT-6B Engines

Kaman K-1125 Helicopter 1 from helicopter is undergoing flight testing with new Canadian Pratt & Whitney PT-6B engines replacing the original Hartzel TT-6B (AW Apr. 8, p. 16). New engine configuration has been made, as aircraft currently is flying without them. Engine mountings required only minor changes to accept the new engines.



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led badly directly to products and processes of importance to industry and, therefore, to economic growth. The development of civilian aviation is a good example. Now, however, world products from our modern defense and space research and development can still be too high in the program, because many oriented toward the special and equipment needed for modern warfare and for space vehicles.

"The severe requirement that we compete successfully on the world scene in defense and in space is now matched by the need to insure our secure growth. Some of our industries are now at a disadvantage in world markets, often because other nations are spending a higher proportion of their national income than we are to stimulate the production of new products and processes. To compete we must make more effective use of our scientific and technological capabilities."

Commerce Dept. figures reveal:

- U.S., with a population of 180 million and Western Europe, with a population of 200 million are now making approximately the same investment in civilian technology. But Europe is increasing its effort at a far more rapid rate. It is doubling its investment every three years, compared with only 25 years for the U.S.

- OX a total annual government outlay of \$12.5 billion for research and development, \$11 billion now goes into defense and space programs related directly or indirectly to the military.
- Non-government research has lagged over the past decade in which federal expenditures to government contracts. Between 1953 and 1965 non-government research increased from \$2.2 billion annually to \$4.5 billion while government expenditures increased from \$2.7 billion to \$12.5 billion.

In addition to directly stimulating the civilian economy, the Administration is also giving the provisos of its desire to stimulate by way of patent policy. A government-wide policy is being studied under the direction of Dr. Wiesner.

Under it the main criterion to determine whether a government contractor should be given patent protection would be: Will the contractor exploit the invention for the benefit of the economy? The criterion would be: Would the economic benefit more if the government retained patent rights and granted licenses to other firms? Each case would be considered on its own merits.

There is also strong support for its reinforcement of an independent agency created toward the civilian economy to make determinations on patent protection. This was explained in an

official testimony by John A. Johnson, general counsel of National Aeronautics and Space Administration.

"If we were to have a government-wide policy... there should be a single administrator or a single group of people... who should make all these determinations." The determinations might be made with reference to broad questions of public policy, economic considerations, social human considerations, the general progress of the nation and so forth. Thus first things have to do with the space program as such or the defense program as such.

Dr. Wiesner explained in testimony to a Senate small business subcommittee, headed by Sen. Russell Long (D-La.), that a contractor with an established, non-government contract and position generally should be given patent protection, since this would encourage him to make the investment essential to exploiting an invention.

He said that highly specialized defense subcontracting in such fields as small vacuum tubes, transistors and electronic components would fall into this category.

On the other hand, Dr. Wiesner said, major aerospace prime contractors do not require patent protection. The result of these proposals, he told the subcommittee, has been maintaining laws here which will be shown add small government contractors, rather than in commercial exploitation.

Dr. Welch told the Long subcommittee.

"Patents have been used as an incentive to economic progress and they have been used as a deterrent to economic progress. It modifies the incentive in either order as regards the patent device."

If we are to give first priority to the public interest, then the disposition of such inventions financed by public funds should be judged on its own merits."



## First Photos Show Q-2A Formation Control System

QC17 formation control system by Bendix Q-2A. The first photo shows a Q-2A in flight and a Q-2A on the ground. The second photo shows a Q-2A in flight and a Q-2A on the ground. The third photo shows a Q-2A in flight and a Q-2A on the ground. The fourth photo shows a Q-2A in flight and a Q-2A on the ground. The fifth photo shows a Q-2A in flight and a Q-2A on the ground. The sixth photo shows a Q-2A in flight and a Q-2A on the ground. The seventh photo shows a Q-2A in flight and a Q-2A on the ground. The eighth photo shows a Q-2A in flight and a Q-2A on the ground. The ninth photo shows a Q-2A in flight and a Q-2A on the ground. The tenth photo shows a Q-2A in flight and a Q-2A on the ground.

# McNamara Outlines Nuclear Force Policy

Washington — Defense Secretary Robert S. McNamara believes the U.S. should emphasize Russia's buildup of nuclear arms and expansion of submarine forces because this will put less pressure on them to carry out a provocative role in a period of crisis.

That reasoning is one of the main threads running through his recent testimony before the Senate Armed Services Committee. He implied that the more sensible the Soviet actions, the more chance there is that action by both sides could be controlled, ensuring the possibility of a nuclear holocaust.

McNamara emphasized an apprehensive attitude that his strategy does not rule out U.S. use of nuclear weapons in the future and Russia's approach partly, but he held out the hope that Russia's decreased vulnerability may bring her sights away from American cities and onto military targets. McNamara assured testimony again and again during his testimony that this was a hope, not an assumption forming a basis for measuring the U.S. means of deterring nuclear weapons.

"I believe that they [the Russians] are moving toward more inshore nuclear weapons," McNamara told the committee. "I think there is ample

evidence that they are moving to sub-labeled missiles. I think there are probably shooting a minimum toward land and missile sites. In each instance that would increase the instability of their nuclear posture. I think further, however, that it is the move in that direction we as a nation should not feel extreme. We should not feel weaker as a result of that movement. As a matter of fact, it will put less pressure on them to carry out a provocative role in a period of crisis, and this is to our advantage."

Intelligence indicated that Russia is intent on not trying to match the U.S. in quantity of missiles. McNamara said "Therefore I can only conclude that at the present time their strategy as Mr. Khrushchev has outlined is a strategy directed primarily against our cities and not urban centers." He said "The Soviet here or will shortly have sufficient missiles to target all of the major urban areas of this country. It does not require a large number of weapons to accomplish that objective." He estimated an all-out Soviet attack would fall between 10 million and 40 million Americans.

"To deter such an attack against U.S. cities," McNamara said, the Defense

Dept. is striving to maintain an overwhelming nuclear superiority over Russia. Hopefully, this superiority will be so impressive that Russia will not launch a surprise attack, because its leaders will become convinced that the U.S. could survive it and strike back devastatingly. Also, a U.S. weapon superiority is designed to provide the option of using part or all of the nuclear forces in retaliation, he said.

"Our total force requirement is determined on an assumption that we must have sufficient strategic forces to absorb a full Soviet strike and survive with sufficient strength to absolutely destroy the Soviet Union," McNamara said. "Secondly, that in determining the force required to destroy the Soviet Union, we consider the possibility, but it is only a possibility, that we may wish to launch the force in waves. Now the fact that it is launched in waves means that certain portions of it are exposed to potential Soviet destruction during the period it is withheld prior to launch. This is true regardless our requirements for secure communications, secure command and control centers and invulnerable forces." He concluded that this holding back of forces is "much more costly" than a

total launch because it requires more weapons as well as a much higher degree of vulnerability.

However, McNamara said that "while it is improbable, there may be circumstances in which we will wish to launch a nuclear attack of our own, hoping thereby to put the Soviet into a position to avoid our other. I am confident to say that this is not a stated operational policy, this is a choice of an alternative to use as an assumption for calculating force requirements for purposes of obtaining appropriation and authorization of Congress."

He said that no matter how large the conventional forces of the West may be, "I believe in a period in the future, let's say in the remaining years of this century when we can, under today's conditions, operate without a strategic nuclear force of the type we are preparing for this century period." He expressed considerable fear that using tactical nuclear weapons might enable us to exchange of strategic missiles, but argued that the U.S. would not play tactical missiles if necessary.

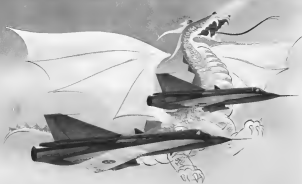
McNamara said that concern about escalation is prompting Defense Dept. officials to look for less powerful tactics than more powerful tactical nuclear weapons. The theory is that the smaller the tactical weapon is, the bigger the threat there is of escalating escalation.



L-T-V Pilots Using XC-142A Simulator

Long Beach-based pilots are developing experience in flight characteristics of the company's XC-142A innovative vertical and short takeoff and landing transport by utilizing cockpit simulator leading to ending completed. Engineers in machine operation has been on control handling and instrument panels. Present board is performing test in development of a new complex XC-142A flight controls panel to be built by the company.

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**Douglas Ejection System Tested With Dummy**

Plasma sequence shows test of Douglas ESD-240C 1-C ejection seat system in simulated ground-level antiegress emergency ejection. Pictures show (1) dummy pilot ready for ejection from test stand; (2) 2,000-lb. two capsule rocket blasting out and 100-ft. dummy into air; (3) parachute deployment at maximum trajectory height of 400 ft.; and (4) dummy floating to crash. System will be used in flight tests of Lockheed XV-6A Homestead VTOL research aircraft. Ejection seat operation is automatic after pilot pulls release control and includes thrust delay to ensure safety and proper sequencing of the ejection seat system.



the firing back of large nuclear weapons.

McNair said this balance of tactical nuclear weapons was not an ability that coalition would necessarily reach from one side using a weapon bigger than needed for the job at hand. He said "I believe the cause of coalition will be the fear of one side or the other that the use of nuclear weapons by the other side is leading to their non-align, and a catastrophic defeat, which they would hope to minimize by matching the use of strategic weapons. This is the circumstance one side would be in, to the extent that one-sided nuclear weapons had been used against it by the other side."

"We have a wide range of tactical nuclear weapons under development, including smaller nuclear weapons," McNair said. "That is in order to try to develop a capability for disrupting escalation of a tactical nuclear conflict into the wider strategic

nuclear conflict, hoping to differentiate between the magnitude of the nuclear destruction associated with tactical nuclear weapons as such a war as to provide an equivalent for, in his terms, to quickly neutralize."

McNair said he said "A large scale attack by the Soviet Union and its allies forces against Western Europe would require quick, square the use of tactical nuclear weapons in order to prevent the onset of Western Europe in the hands of the West. Whether that situation could then be limited to the use of tactical nuclear weapons as an open question is not clear."

Because of these fears about escalation, the Kennedy Administration is trying to ally in areas given their conventional forces to that if the Soviets launch a land attack against Western Europe, they could be "killed" long enough to neutralize. "The only way, actually, of a conflict could go down as

well as, again," McNair said. "The greater flexibility we are looking into our forces give us a greater ability to control and limit the scale of conflict."

Sen. Margaret Chase Smith (D-Me.) said that the threat that the use of tactical nuclear weapons would compel coalition "was definitely not a basic hypothesis during the 1950s." Sen. Strom Thurmond (D-S.C.) said the McNair position, contending that the fear about escalation, was "justifying the actions of U.S. leaders during the Soviet 'We are following the policy of accommodation rather than winning the cold war in my judgment.'" Sen. Thurmond said. "We have to take a strong stand with the Communists, and I am afraid your [McNair's] thinking is going along the State Dept's line that I once thought it was."

Other senators challenged what they considered to be too heavy a reliance on missiles at the expense of nuclear aircraft. McNair repeated his earlier

argument that U.S. forces would be a flexible mix of missiles and aircraft throughout the 1950s (AVF Feb. 11, p. 67).

"The more fear about our reliance on missiles, the more we need to develop aircraft as well as missiles. For example, Atlas, George W. Anderson, chief of naval operations, said "We have a fast weapon system in the manned bomber the Strategic Air Command has done a wonderful job, we have a command capital reinforcement in it, and I certainly want to keep that force modern until we do know that the Atlas or Titan or the Minuteman or even the Polaris are thoroughly reliable."

## Brown Views Space For Military Support

Washington—Dr. Harold Brown, director of defense research and engineering believes space will be an important area for supporting military activities in the future, but that it is "conceivable but not likely" that weapons will be launched from space into earth targets.

The latest thinking on space as a military environment was given to the Senate Armed Services Committee during hearings on the Fiscal 1964 budget. This was Brown's response—taken from a prepared transcript—when Sen. Strom Thurmond (D-S.C.) asked "what part do you measure that space is going to play in the wars of the future and what are we doing to meet that requirement?"

"Space is a place to operate," Brown said, "in a place where you can do some of the things that you can do in air, or in the air better than you can do in either of these places, and in some cases you cannot do them in well, that space is a place will be an important area for a number of support activities, things that involve (deleted) things that involve early warning, things that involve intelligence, things that involve communication. I believe that more or more of these things may be done better in space than any other way, and we are currently finding that kind of activity fairly, that is to say supporting intelligence development projects in all of these areas."

"I believe that it is conceivable but not likely that space may become an area on which armed conflict takes place directly from space, that is it may have one that the best way to launch a vehicle which carries war other because it is doing (deleted), as because it is carrying a bomb or for some other reason to launch it out of existence from another thing based in space. I believe that it is not really viable to believe you can probably do it better from the

ground, and we have a program that will allow us to do it from the ground."

"I think that it is possible that in the future we will want to put more up in our military space vehicles so as to make the equipment work better, and if that is the case, we have to have a larger period of time than we have now, we have to be able to support more in space over long periods of time, and so on."

"I am not at all concerned, by the way, that this will actually go to be serious, but I think it might well be, and for this reason we have our own program to provide these larger payloads, the Titan 3, for example, to co-

operate with NASA and, perhaps, contribute to that program, to do more about Gemini and there is the Devo Star program which we are now going to examine with respect to the Gemini to see whether we can put them together or determine the optimum use of resources to between those two programs. I think that shows how I envisage things."

Sen. Thurmond: "Do you feel, as someone has expressed it, that the nation that controls space will control the world? Do you feel that strongly?"

Brown: "I would not subscribe to that statement partly because I am not quite sure what control of space means. I do

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not see that it is really feasible to send mail space because a month, will always have an ad-charge in space over its own territory because it not only operates from the ground up into space.

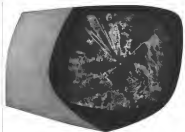
I do not see a way, for example, in which space can be controlled in the sense that one can prevent satellite stations from being fired into going through space and coming down there. If a country could do that it would be kind of as a far step to control the world and not continue to work on ideas that might have that effect. But I think in the end it is not going to be feasible.

**Sen. Thurmond:** "How do you envision the purpose of a platform in space and what it could accomplish?"

**Dowd:** "A platform in space is good (deleted). It is good for doing communications, and it may be that you would want a big enough platform to put a man up there because he was able to make the equipment work better. That, I think, means to be seen."

**Observation of weather in another one.** I do not quite see the purpose of shooting weapons from a pilot plane down into the earth, not because it cannot be done but because I think it can be done better from the earth to the earth."

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### Gamma Wholesalers

Special meeting of Gamma wholesalers will take place at the company's Whistler, Am., Union Ave. 28-38 Avenue, a discussion and international trade and public introduction of the new London Express, November Model 155 Stratosphere (AVR) May 15, p. 101.

A team representing airlines, from the scheduled and ferry-carrying sales managers, will leave the Gamma for May 15.

Seven will join 15 U.S. and Canadian airlines over a network period to introduce the airline to various regions. From other airlines will cover the international market. One will start a European tour following flights at the New Air Show in June. One Whistler will begin a Far East tour May 15 beginning in Tokyo.

A third will start a South American tour May 15 from San Paulo, Brazil, and the fourth will begin a Central American tour May 15 from Mexico City. The fifth airplane of the group will begin an African tour in March, starting from Mauritania, Liberia.

Further plans delivery of the first Stratosphere to a scheduled May 15.

Schedule calls for building up on next production rate from approximately three Stratospheres weekly to more than two-dozen in 60 orders this year for the aircraft.





**H-21A TEST HELICOPTER** is shown lifting all on remote-controlled crash flight. Testing cool was for data recording. Frangible seatings helped that deformation.



**SHORTLY AFTER IMPACT** from 50 ft., seat and main gear collapsed. Note seat bearing loads heritage. Main wreckage show in dark paint band and on tail rotors.



**VERTICAL FORCE FLATTENS** heritage (above) in aircraft rolls left. Note dummy motion in descent. Seat ingested fuel tank exploded (below) in return fall runway.



**DUMMY IN EXPERIMENTAL SEAT** No. 1 (left) and No. 2 (shown on right). Dummy was pitched

## Crash Tests

By Donald E. Fink

New York—Helicopter test crash program, conducted by the Flight Safety Foundation, is yielding dramatic force data on which Army is basing new helicopter design requirements as well as improving troop crash survivability.

Specifications covering a new troop seat design already have been written by Army's Transportation Research Command (TRC), sponsoring agency for the crash tests. The specifications will be revised at Army's Materiel Development and Logistics Command later this month just as their release to industry to initiate design requirements. The new design requirements will be applied to all helicopters and VTOL aircraft presently under development for Army.

Army also is applying the test requirements to operational aircraft by developing from which will improve their troop crash survivability. A tactical program has been started in conjunction with this, according to Frank P. McCurt, TRC's assistant director of aviation, to check all helicopters in Army's inventory for structural deficiencies and to determine if corrective action is economically feasible.

Army's interest in improving crash protection for occupants of its helicopters has come about naturally, with their increased use. McCurt said Little vertical force data on which to base safety design requirements was available, however, until Army contacted the Foundation to begin its test crash program in 1961. The program had been



was held upright and sustained survivable shock. Second photo shows energy absorber fully shocked. Horizontal and side braces tilted on into ballhead and sustained fatal hard shock. Note pulled out at base of seat's center energy absorbing leg. Seats will undergo further tests.



## Used to Study Survival in Helicopter Impact

continued since then on a cost reimbursable contract with an annual budget of \$510,000.

The test studies, which have been conducted at Deer Valley Airport in Phoenix, Ariz., by the Foundation's Aviation Crash Injury Research Division, involved investigation of three main areas in which crash survivability can be improved through redesign: Vics are:

- Seat and restraint harness components
- Fire suppression
- Airframe and landing gear shock absorbers

As suggested and two acceleration-based, general helicopter have been crash tested to find out more powerful crashes are scheduled in the continuing program. The experimental aircraft have included Sikorsky HO4S and two Bell UH-1Hs were dropped 10 ft. onto a runway from a crane which was moving at a forward speed of about 50 mph.

The two powered tests were conducted with Sikorsky HO4S, one with a helicopter drone flight system developed by Kaman Aircraft Corp. The remaining two tests will use two Cessna 441-41s one Bell UH-1H (UH) prototype and three more Sikorsky HO4S.

The next test, scheduled for later this month, will involve the crashing of an HO4S to test several experimental seats and later restraint devices which the Foundation has developed using data from the second HO4S crash.

Three Foundation experimental seats underwent preliminary tests in the test

and H-21A crash, which was designed to simulate a severe but potentially survivable crash.

Experimental seat No. 1 had over head and side attachment loads and was suspended from an 800-lb. crash energy absorber. The energy absorbers consisted of small pulleys with 5-in. lengths of wire cable wound into them. Pulleys were attached to a frame on the upper fuselage. When the seat was dropped downward by the vertical force of the crash, energy was dissipated as the cables were pulled from the pulleys and the seat was brought to a gradual halt.

Experimental seat No. 2 was a more conventional design with lateral tether support members attached to the fuselage at the top of the back and at seat level. A single metal extension energy-



**CLOSE-UP VIEW** of "poking" type energy absorber shows fully shocked cables, which was engaged after the tests show down. Arrangement was designed to 40 ft. drop in vertical velocity. Dummy in the seat sustained only a 20g shock.

absorber leg extended from the center of the seat support structure to an attachment in the floor. Downward force on the seat pushed the extended leg into the floor attachment, where it split and pulled back absorbing energy through its deformation.

The third seat was a simple device made of sticks of paper balsa wood. Vertical force, energy created by the impact, was absorbed by the crushing action on the balsa wood.

Included in the HO4S were several Alaskan anthropomorphic dummies, instrumented to measure acceleration in various parts of the body. Three were seated on the experimental seats, two were strapped on conventional military lines, one was seated on a conventional commercial helicopter seat and one of the dummies was seated in the pilot's seat.

The aircraft was flown to a height of about 60 ft. and a forward speed of 30 mph before it was released on the runway. The helicopter hit at an angle of about 80 deg with the ground and at a rate of descent of about 40 ft./sec., slightly over 27 mph. The crash was considered survivable because some "usable" space remained in the fuselage after impact.

The nose gear failed upon impact and was driven up into the bottom of the cabin just aft of the cockpit. Both main gear assemblies failed immediately after the nose gear and the fuselage parts ripped into the fuselage, tearing the cross floor rail. A total of 58 shrapnel of element data was obtained from accelerometers on the dummies.

## SAFETY



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If you're the type of design engineer we're looking for, chances are you've never answered a recruiting ad. Probably you've never had to. You've pretty much had your pick of positions since you left school. You're an outstanding performer in a field where there are serious shortages.

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## Ready to answer your first ad?

Here are a few facts about Honeywell that may help you make that decision. Start with growth. We've grown fast, but steadily and consistently with diversified projects and contracts. We've tripled our design engineering staff in the last 5 years. This would be a good point in our growth to join the Aero Division. You'll have the variety and stability that goes with a broad-based company, plus a great opportunity for future personal growth and advancement.

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Good pay. Time to get a merit raise, and we'll fit that way. We pay and promote to recognize individual performance and progress. You won't get lost or pigeon-holed here. We'll even help you advance, by providing full tuition and book costs

for advanced degree work. (Right now, over 80 of the men in our Aeronautical Division are doing graduate work at the nearby University of Minnesota.)

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At Honeywell, you're on your own. We hire a man to do a job, not to tell him how to do it. Tough competition replaces the confining supervision you find at many companies.

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**Flight reference and navigation systems (CSSE OR AE) 8 years' experience in attitude and navigation system design, and in applying vehicle motion equations. Experience in control system (including stability and control) analysis. You'll translate requirements to system components at the component stage. Must be good at technical communication, written and oral.**

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**Employment is a two-way street. We've told you a few things about Honeywell. Now, how about you? Maybe it's time to answer your first recruiting ad. Just mail a brief summary of your qualifications, including salary requirements to:**

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To explore professional opportunities in other Honeywell locations, coast-to-coast, send your application in confidence to Mr. R. G. Robinson, Honeywell, Minneapolis 8, Minnesota.

due of the wreckage. The tanks would have to have self-sealing fuel but one plug and would be superpressured. Self-sealing tanks also would have to be sealed on the fuel line ends to seal fuel in the lines after the tanks break loose. Tests with experimental fuel, now tanks have had partial success. Development of better designs is planned for subsequent test cycles.

• **Development of lightweight tanks.** Efforts also are being made to develop shiftable self-sealing tanks for jetted fuel storage. These tanks would have to be capable of withstanding high shock loads and must purchase without burning. A Goodrich Rubber Co. tank, made of reinforced rubber currently is undergoing preliminary testing in the Combustion.

• **Fuel substitution.** Chemical services which will self-seal fuel and prevent it from spilling out, even if tanks are ruptured are being developed for the Aero test program by the Southwest Research Institute in San Antonio, Tex. One chemical would be used in the tank during its normal use and the other would be stored in a reservoir next to the tank. Injection of the second chemical into the fuel would cause it to self-seal. Fuel had worked here, but would not spread or burn explosively. One successful test. Successful balloon jelling tests have been conducted, but considerable development work is required before the jelling technique

can be applied to a full-scale aircraft.

The shock absorbing qualities of urethanes and loading gear assemblies also are being explored in the tests. At rates of descent approaching 40 ft./sec., film and accelerometer data showed the loading gear struts and shock absorbers collapsing without appreciable change in the rate of landing descent.

A shiftable gear assembly is necessary on a helicopter to reduce ground reaction, but gear design which can resist deceleration forces to absorb shocks above normal landing stresses are under development in several helicopter companies.

## Sikorsky Technique

United Aircraft's Sikorsky Div., has developed one which has a telescoping strut assembly that has a shear pin capable of withstanding normal landing loads on a ship. If the rotor arm is driven past its normal stroke, a greater force, it breaks the pin and runs into an upper housing containing an aluminum honeycomb core. The end of the rotor arm is absorbed at the impact energy.

Being GS's Vertical Descent is experimenting with a metal shear plate that shifts the strut end is down of landing forces on the gear could remove loads. Impact energy is absorbed as the strut ends into the edge of the plate. Shear plate device can develop full possible application to the H-21.



## Valiant Fitted with BS.53

First photo of a Valiant V bomber fitted with a Bristol Siddeley BS.53 Pegasus engine. Second image shows the engine and other details specifically designed for the light test program. Third is a close-up of the engine during idling to prevent ingestion of debris during up to the nose wheel. Light test will provide engine testing and reflecting along with engine testing under steady flight conditions. Fourth chamber housing possibly will be tested on the test and as part of development of the core power BS.53 engine which will be used on the Hawker P.1154 supersonic VTOL strike fighter.

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—one approach is to roll back two boundaries of the command and control data problem: the amount of information that can be reliably gathered and stored... and the amount that can be presented to the human decision-maker in real-time without exceeding the threshold of human saturation.

An illustration of this double-benefit systems approach may be seen in the Strategic Air Command Control System 485 L, for which ITT International Electric Corporation is Prime Contractor.

Data enters the 405 L network from Remote Communication Centers all over the world. Each RCC can accommodate as many as 3,000 messages per hour by means of up to 20 computer-based consoles. All messages transmitted within the System are automatically routed, recorded, and error-checked by Data Transmission Control Centers located at each SAC Headquarters. Information flows into the Data Processing Center, where a high-speed computer compares events related

by RCC's with files stored in its memory. The DPC will automatically alert the SAC staff in any significant deviation between actual and planned events.

At the critical 405 L interface, assimilation of the vast quantities of information funneling into SAC command centers has been greatly enhanced by a recent DTE development—data presentation in color. Operating at speeds that appeared infeasible only a short time ago, the new display system enables computer outputs to be converted to stable, synthetic forms... photographs... developed and projected onto 16 large control center screens in as many as 7 colors in a matter of seconds. If you tour our Pomona, New Jersey facility, you'll find a complete operational prototype of 405 L, occupying over 20,000 square feet in one of our buildings. This unusual installation can be used to simulate almost any command and control or information system our engineers wish to study... military or commercial.

### OPPORTUNITIES IN MANY COMMAND AND CONTROL AREAS NOW OPEN TO SYSTEMS ENGINEERS, ANALYSTS, AND OTHERS

**PROGRAMMERS/ANALYSTS.** For real-time programming, analysis and development. Repair and testing equipment, automatic programming systems, including optical data display machines, digital logic programs, automatic memory, partitioned or language, and test programs.

**OPERATIONS ANALYSTS.** To evaluate systems requirements in actual control, air traffic control, input and control systems. Also, to design in systems that communicate and also not not relevant.

**SYSTEM IMPLEMENTATION ENGINEERS.** Electrical engineers in the field, test, air processing and evaluation of installed systems, systems repair systems. Also, control systems and resources. Also, test procedures for installation and integration of digital systems, control systems.

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### High-Speed Camera

High-speed framing camera for studying almost any phenomenon such as turbulent gas combustion, detonations, solid rocket jet ignitions etc. can take photographs at rates from 200 to 15,000 per second, the manufacturer says.



Called Dywida Model 390, the camera records 224 standard 16-mm frames in each run. At top speed per frame are exposed 28.6 microseconds apart at automatic shutter speeds of 0.7-1.8 or 1/7 microseconds. At per frame are taken at exactly this rate, the manufacturer says. A tachometer indicates frame rate to within 5% to said accuracy with 0.0015.

Berkley & Whites, Inc., San Carlos, Calif.

### Hydraulic System Cleaner

Portable hydraulic fluid filter and dehydrator speeds aircraft service and ground support equipment hydraulic system cleaning, the manufacturer says.



Combustion particles as small as two microns removed and vented.

# ENGINEERING EMPLOYMENT OPPORTUNITIES AT NORTH AMERICAN AVIATION'S SPACE AND INFORMATION SYSTEMS DIVISION

North American Aviation's Space and Information Systems Division is expanding its capabilities into all phases of the aerospace technologies. Current programs include manned spacecraft, large booster systems, missile weapon systems, recovery systems and research in all of the aerospace sciences.

Two of the most challenging areas which are now staffing include the Electronic Systems and Reliability Engineering groups.

**ELECTRONIC SYSTEMS** • Engineering opportunities are available in the area of communications, instrumentation, on-board test, display, guidance and navigation, flight control, and electronic interfaces for space systems. Assignments in general require from three to ten years experience in the applicable fields.

**RELIABILITY ENGINEERING** • These positions provide opportunity for original contributions to the development and application of reliability techniques, program insurance and control measures. Several openings are available now for engineers with BS degrees and several years experience in design analysis, data systems, criteria and requirements, and test planning.

Key engineering jobs are also available in the following areas: Flight Dynamics • Structural Design & Analysis • Propulsion Systems • Information Systems • Thermodynamics • Systems Programming • Engineering Simulation • Guidance Sensor Systems • Aerospace Ground Equipment • Guidance and Control.

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All qualified applicants will receive confidential consideration without regard to race, color, religion or national origin.

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We are currently seeking qualified individuals for the following positions in our New York City office:

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A successor to a series of vehicles that will effectively demonstrate on earth, the unique problems and characteristics of an actual lunar landing. It will allow a jet engine to take off vertically and climb to an altitude of 2,000 feet. The jet engine will be started back to provide lift only, the vehicle will be launched by a rocket. Bell Aerospace Co. has been selected to design, develop and construct this vehicle.

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A new, small, experimental research vehicle will be tested and prepared in the United States under license from Bell Aerospace Co. of France.

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A lightweight aircraft of integral, integrated design in which the propellers and control surfaces are utilized efficiently during all phases of hovering, transition and conventional flight. We are presently in our six month, 40-month program to achieve low altitude flight.

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Resumes are invited. Please send to Mr. Thomas F. White, Dept. E-22.



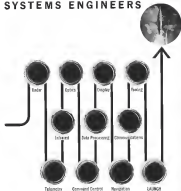
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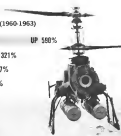
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**DRAG ENGINEER.** Must have experience in drag reduction field from theoretical inception to wind tunnel test and analysis to flight test.

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